

**THE "CAPABILITIES GAP" IN DESERT STORM:  
A *COALITION* AIR CAMPAIGN CASE STUDY**

BY  
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## **Disclaimer**

The conclusions and opinions expressed in this document are those of the author. They do not reflect the official position of the US Government, Department of Defense, the United States Air Force, or Air University.

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### *Abstract*

This study examines how the differing capabilities among the coalition air forces affected the Desert Storm air campaign. The author initially compares coalition air forces using several areas identified as capability gaps during NATO's air war against Yugoslavia. Rather than clear-cut distinctions, the Gulf War US-led coalition represented more of a continuum in air combat capability. Next the air war is reviewed to determine how these capability differences affected the planning, execution, and attainment of coalition air campaign objectives. Although in the macro sense capability gaps did not seem to hinder the achievement of objectives, several contextual elements mitigated not only their effects but also the perception of those effects. Finally, the study recommends one possible framework for conducting future coalition air campaigns based on the Desert Storm experience.

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## **Chapter 1**

# **INTRODUCTION**

### **Background on the “Capabilities Gap”**

After Operation Allied Force, the NATO Air Component Commander Lieutenant General Michael Short warned that without significant European investment NATO was in danger of “creating second or third teams within the alliance.”<sup>1</sup> He was referring to the growing gap between US and allied military capabilities versus the alliance’s corresponding decision-making process where consensus is the norm. The air war over Kosovo renewed a somewhat dormant “interoperability” debate within the US military and abroad. Strongly prompted by the US, NATO renewed emphasis on its Defense Capabilities Initiative (DCI), which pledged to close the “technology gap” between the United States and its European members.<sup>2</sup> Some doubt NATO’s ability to turn promises into reality. Given the price tag of advanced aircraft and related systems, arguably no country will be able to match the US in this area. As of this writing some Europeans are pushing for an acceleration of the European Security Defense Identity (ESDI), which involves the formation of a European defense structure independent of the US and possibly NATO, most recently represented by the 60,000 strong European Rapid Reaction Force.

Within the US military establishment, there are two primary schools of thought regarding integrating US and allied air forces into future coalition campaigns. One is that current technology is the price of admission. Without it, an allied air force would either be excluded or relegated to an insignificant role. The counter-view is that the US military

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<sup>1</sup> William Drozdiak, “Allies Need Upgrade, General Says”, *The Washington Post*, 20 June 1999, A20.

and the department of defense's belief that only by closing the gap can allies contribute more to future coalition operations.

### **Defining interoperability and capability**

This ongoing debate has made “interoperability” one of the Pentagon's hottest buzzwords. Unfortunately, amidst all the rhetoric the term's meaning has blurred, coming to mean different things in different circumstances. Joint Pub 1-02 broadly defines interoperability as:

The ability of systems, units, or forces to provide services to and accept services from other systems, units, or forces, and to use the services so exchanged to enable them to operate effectively together.<sup>6</sup>

At the tactical level, one example of interoperability is the formation of a multinational strike package. Collectively can they get to the target and back while achieving the desired level of target destruction? In an operational sense interoperability concerns such things as the mix of platforms and capabilities available to planners, adequacy of air defense for the perceived threat, and the ability to strike the intended target sets given the anticipated threat and environmental conditions.

Capability deserves definition as well and breaks down into two interrelated parts. The first is purely technical and describes the actual hardware and, increasingly, software that makes up a weapons system. The second which is intangible and often more important is the training and doctrinal development supporting a technical capability. A good example is precision-guided munitions (PGM), which when properly handled can precisely penetrate and destroy hardened military facilities. They are also complicated pieces of equipment which, in the hands of the poorly trained can just as precisely miss their intended target. Because of the scarcity of open sources documenting such intangibles, this study focuses on technical capabilities.

### **Thesis Research Question**

The first step in any study of the “capabilities gap” should dissect a recent air campaign from a coalition perspective, examining how the differences in technology and

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<sup>6</sup> Joint Pub 1-02, *DOD Dictionary of Military and Related Terms*, 23 March 1994 (amended through 1 September 2000), 235.

other capabilities among coalition members shaped its makeup and outcome. The scale and diversity of the coalition in Desert Storm makes it well-suited for such a study. Ideally, the next step would be to compare Desert Storm with a similar large-scale coalition air campaign such as Allied Force. Unfortunately, the classification of primary source material for Allied Force precludes a thorough analysis at this time. Thus this study's research question: how did the differing capabilities amongst the coalition air forces affect the Desert Storm air campaign?

To facilitate a future comparison of the two air campaigns, capability shortfalls identified in the Congressional Research Service's *Kosovo: Lessons Learned from Allied Force* form the initial capabilities set for the following analysis.<sup>7</sup> These shortfalls include: PGMs, laser-designator capability, night-vision capability, secure interoperable communications, high fidelity Identification Friend or Foe (IFF) systems, electronic warfare capabilities, and aerial refuelers. Additionally, the concluding chapter lays the groundwork for a future comparative study between Desert Storm and Allied Force by addressing several possibly pertinent differences in the two campaigns.

## **Limitations**

Availability and access to information, or rather the lack of access to information, has greatly shaped this thesis. Even after 10 years some portions of the Desert Storm record remain sensitive, especially in the areas of electronic warfare and specific allied capabilities. There is also a paucity of detailed information regarding the operations of foreign militaries such as the French Air Force (FAF), Royal Saudi Air Force (RSAF), and Gulf States air forces. Security, political, and cultural factors are responsible. Understandably, countries are hesitant to provide information concerning military capabilities, even to allies. Openly discussing capabilities which might place friends in a bad light is also considered "politically incorrect." Finally, historical recording and analysis is not prevalent in some cultures. A British Ministry of Defense foreign sales representative to Saudi Arabia postulates the Bedouin's desert existence does not lend

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<sup>7</sup> Paul E. Gallis, *Kosovo: Lessons Learned from Operation Allied Force* (Washington, D.C.: Congressional Research Service, Library of Congress, 1999), CRS-15.

itself to such introspection.<sup>8</sup> In this regard, General Khaled bin Sultan's *Desert Warrior* is a notable exception.

Another limitation is the subjective nature of the historical database. Available data of coalition air force involvement is sometimes clouded by hyperbole while void of critical analysis. Even the well documented USAF side of the story is tinged with air force salesmanship and makes only passing comments about other air force contributions. Where possible multiple accounts of events have been reviewed to minimize these biases.

These limitations are partly offset by the fact that most of the leadership involved in planning and executing the air campaign wore an USAF uniform. Therefore, despite the lack of commensurate material on other air force involvement, the majority of the historical record presents the air campaign through the eyes of these key USAF decision-makers.

## **Sources**

Most of the US primary source material is still classified secret. The author was generally successful in declassifying pertinent portions of the classified record for primary reference. When declassification was not possible the author has relied on reliable secondary sources such as the Gulf War Air Power Survey (GWAPS).

Allied air force sources included books, articles, and other personal accounts written by both Desert Shield and Storm participants. The author requested and received responses from both the Royal Air Force (RAF) and FAF official historical agencies. Secondary sources such as Jane's Defense Journal were consulted to ferret out additional information, especially about the Gulf States' airpower capabilities. Finally, personal interviews of coalition participants rounded out the database.

## **Study Assumptions**

This study's primary assumption is that examining five of the Gulf War coalition's largest airpower contributors (e.g., the USAF, USN, Saudi Arabia, United Kingdom, and France) will provide representative and detailed data for analysis. With the exception of the USMC, they were the five largest sortie contributors to Desert

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<sup>8</sup> Dominic Duffy, UK Ministry of Defense Saudi Armed Forces Project, telephone interviewed by author,

Storm.<sup>9</sup> Collectively they represent 85% of air interdiction, 91% of offensive counterair (OCA), and 94% of defensive counterair (DCA) sorties flown. They have the additional advantage of including Arab as well as two different European perspectives. This is not to denigrate the important contributions of other allies, and where possible other air forces will be included to the extent allowed by available information.

This assumption implicitly treats US naval air as a separate air force. This may seem counter-intuitive in a study of coalition air operations. However, in terms of combined force air component commander (CFACC) staff representation, planning involvement, capability differences and corresponding force employment, that is the role US naval air played. Not just the US but the USAF dominated all aspects of the Gulf War air campaign. This is an important consideration in understanding the working of the coalition and will be expanded in later chapters.

Since the majority of shortfalls identified in the Kosovo report and preliminary Desert Storm research centered on fighter operations, this study confines itself to such operations, both air-to-air and air-to-ground, and support activities like air refueling and electronic combat.

The final major assumption is that readers have a working knowledge of Desert Storm, including its basic background and general chronology. Therefore the discussion is confined to pertinent contextual elements, specific capability differences, and their interaction in the air campaign.

## **Overview**

Chapter two briefly reviews the conflict's physical and political environment before detailing the allied air order of battle in terms of the capability categories outlined above. With a foundation of context and capability differences, chapter three looks at planning and training prior to the opening of the air offensive, including air exercises conducted before and during Desert Shield. Chapter four turns preparation into

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15 February 2001.

<sup>9</sup> The particulars of USMC air involvement mostly deal with doctrine and not capability differences. Operating F/A-18s like the USN and AV-8 ground attack aircraft similar in capabilities to the USAF A-10, most USMC air was held in reserve during the first few weeks of the air war and then flew predominantly counterland missions in the last half of the war. For these reasons and in the interests of focusing on allied capability differences, USMC air was not made a priority in this study.

execution, exploring how capability differences affected tactical execution and attainment of air campaign objectives. Finally, chapter five reviews the most intractable capability differences in the coalition and how and why they were overcome, as well as why some differences did not measurably affect the campaign. This discussion will summarize the role of contextual factors in coalition operations. With an eye to the future, it will suggest areas for further research including work-arounds to the gap.

## **Chapter 2**

# **CONTEXT AND CAPABILITIES**

### **Introduction**

The first part of this chapter outlines the context in which Desert Storm took place. Although not the focus of this study, these environmental and political factors are important since they shaped the way specific capabilities affected the air campaign. Of similar importance is a broad understanding of the nature of the threat posed to coalition air forces by the Iraqi integrated air defense system (IADS). The bulk of the chapter explores the technological capabilities of coalition air force fighters and support aircraft, highlighting pertinent differences. The USAF will serve as a benchmark for these comparisons. Differences ranged not only between aircraft, avionics, and weapons, but also in the interface of these various components. For example, even though a laser guided bomb (LGB) can be employed at night, an aircraft's targeting pod, or the aircraft itself, may be limited to day only employment.

### **Context**

#### **Physical Environment**

Most of the region, especially the Kuwaiti Theater of Operations (KTO), could be classified as featureless desert with little vegetation. The "Fertile Crescent" formed by the Tigris and Euphrates Rivers contains the bulk of Iraqi agriculture. Nowhere does growth provide adequate cover for camouflage or concealment. The lack of discernible terrain features required the Iraqis to entrench equipment to hide it. But the climatology of the desert, especially the rapid

heating and cooling of the ground at night and early evening, provided the background contrast that made Iraqi armor susceptible to detection by aircraft mounted infrared (IR) sensors.<sup>10</sup>

Immediately following the conflict USAF Chief of Staff General Merrill McPeak claimed that weather had been the worst in 14 years and twice as bad as predicted.<sup>11</sup> While technically true, when compared to previous combat conditions encountered in Europe and Vietnam, the overall weather conditions in the theater had been quite good.<sup>12</sup> However, weather was a major factor in the early part of the air campaign and during the ground offensive, slowing the initial timeline for achieving desired effects. Ceilings averaging 500-3,000 feet forced pilots supporting ground forces to fly lower, where they were more susceptible to ground fire and short range missiles. One senior officer estimated weather caused air power's effectiveness to drop from "98% to 92%."<sup>13</sup>

## **Political Environment**

With the fall of the Berlin Wall in October 1989 and ensuing disintegration of the Soviet bloc the "Cold War" was coming to an end. Initial reaction in the west was cautious optimism, with many countries not ready to demobilize in the face of an uncertain threat. But by mid 1990 the pace of events was unmistakable. Several NATO countries were conducting internal reviews to determine their post-cold war military force structures—the US termed its effort the "base force."<sup>14</sup> But bureaucratic inertia can be difficult to overcome and caution remained the watch word, with most of drawdowns remaining on the drawing boards only.

Political factors directly affected the employment of capabilities in Desert Storm. With the formulation of the Powell-Weinberger Doctrine in the wake of Vietnam, the US was poised to deploy overwhelming force and focus on minimizing friendly casualties and collateral damage in order to maintain popular support for the war effort. Recognizing their junior partner status, the British still sought to maintain maximum influence in the coalition through their participation. NATO and other experiences had taught them the way to secure such influence lay

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<sup>10</sup> Thomas A. Keaney and Eliot A. Cohen, *Revolution in Warfare? Air Power in the Persian Gulf* (Annapolis: Naval Institute Press, 1995), 144.

<sup>11</sup> USAF Chief of Staff General Merrill A. McPeak, Briefing to Pentagon Press Corps, 15 March 1991.

<sup>12</sup> Keaney and Cohen, 146.

<sup>13</sup> USAF Air Warfare Center, *Desert Storm: An Overview of Air Operations* by John A. Corder, Major General, USAF, 21 December 1991, 59. (Secret) Information extracted is unclassified.

<sup>14</sup> Colin Powell with Joseph E. Persico, *My American Journey* (New York: Random House, 1995), 444-5.



in contributing capabilities matching those of the leading ally.<sup>15</sup> France's perceived stature in the Arab world and internal politics created an incremental commitment. While Prime Minister Mitterand supported the US, his defense minister Chevènement worked hard to restrict French military participation.<sup>16</sup> With their defense minister's resignation after the opening of hostilities, the French graduated from a Saudi Arabia defense only posture to full participation in the coalition. Saudi Arabia's King Fahd enjoyed a special relationship with the Kuwaiti royal family. Saddam's perceived threat to regional stability allowed the formation of a Saudi-Syrian-Egyptian axis willing to fight an "Arab brother" to restore Kuwaiti sovereignty.

### **Iraqi threat**

An accurate assessment of the pre-conflict Iraqi IADS depended on the melding of personnel capabilities with corresponding equipment. On paper the Iraqis posed a formidable threat to coalition air forces. Their air order of battle included 700 mostly Soviet supplied aircraft.<sup>17</sup> Surface systems included a mix of Soviet and French supplied fixed and mobile surface-to-air missiles (SAM) and anti-aircraft artillery (AAA) linked by a French built command and control system called KARI. But intelligence gleaned from the Iraq-Iran war revealed flaws in training and employment doctrine. In October 1990 the CIA assessed:

The Iraqi Air Force would not be effective because it would either be neutralized quickly by coalition air action or it would be withheld from action in hardened shelters. Within a few days, Iraqi air defenses would be limited to AAA and hand-held and surviving light SAMs. The [former] would present a significant threat to low-level air operations. . .<sup>18</sup>

SPEAR, a US Navy intelligence organization, circulated a similar assessment predicting that Iraq's interceptor force would be quickly neutralized and that SAMs would remain its primary air defense weapon.<sup>19</sup>

Another important aspect of the Iraqi IADS was its segmented nature between Iraq and Kuwait. Iraq had the more established infrastructure, with a full complement of

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<sup>15</sup> Dan Keohane, "British Policy in the Conflict," in *International Perspectives on the Gulf Conflict 1990-91*, ed. Alex Danchev and Dan Keohane (New York: St. Martin's Press, 1994), 162.

<sup>16</sup> HRH General Khaled bin Sultan with Patrick Seale, *Desert Warrior: A Personal View of the Gulf War by the Joint Forces Commander* (New York: HarperCollins Publishers, 1995), 267.

<sup>17</sup> *Gulf War Air Power Survey (GWAPS), Volume V, Part I, A Statistical Compendium* (Washington, D.C.: US Government Printing Office, 1993), 18.

<sup>18</sup> Keaney and Cohen, 108.

<sup>19</sup> Ibid, 109.

strategic SAMs, early warning and target acquisition radars. Newly annexed Kuwait's defenses were less complex and lethal, comprised of mostly mobile SAMs and AAA attached to Iraqi ground units. Within Kuwait the Iraqi defenses were further stratified, with the most capable systems covering the Republican Guard divisions.<sup>20</sup>

## Capabilities by Air Force

### USAF

The technological superiority of USAF strike forces was epitomized by the F-117 Stealth Fighter. To optimize stealth qualities, planners need to have an extremely accurate description of the enemy threat radar array. It also has no air defense armament and little maneuverability, thus restricting it to nighttime employment. The F-117 could also self-designate LGBs, as could F-111F Aardvarks and F-15E Strike Eagles. The F-111F employed an internal pod combining a nighttime detection capability with laser designation.<sup>21</sup> F-15Es required two externally mounted pods to match this capability.<sup>22</sup> All F-15Es came equipped with navigation pods providing a night vision ability through their heads-up-display. Targeting pods offered an IR sensor in addition to a laser designator, that could be slaved to the ground mapping radar or cued independently. Because only six targeting pods existed for the 48 F-15Es in theater these aircraft employed “buddy lasing,” where targeting pod equipped jets could designate for other F-15Es.<sup>23</sup> As a derivative of the F-15C air superiority fighter the Strike Eagle could be employed at low or medium altitude, day or night. The F-111’s terrain following radar gave it a low altitude night/all weather strike capability. Carrying only short range missiles for self-defense and lacking suitable air-to-air maneuverability its crews concentrated on low altitude nighttime employment.

The USAF brought a large array of guided and unguided munitions to Desert Storm. LGBs made up the majority of USAF PGMs and represented technology that had evolved since the Vietnam War. Guidance and control for LGBs had progressed through three levels.

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<sup>20</sup> Fred Frostic, *Air Campaign Against the Iraqi Army in the Kuwait Theater of Operations*, RAND Report MR-357-AF (Santa Monica, Calif.: RAND, 1994), 43.

<sup>21</sup> The PAVE TACK used an IR sensor for day/night targeting.

<sup>22</sup> The system is known as LANTIRN for low-altitude navigation and targeting infrared night.

<sup>23</sup> *GWAPS, Volume IV, Part I, Weapons, Tactics, and Training*, 46-7.

Paveway I's were the oldest in the inventory. Referred to as "bang-bang" guided, canard surfaces made full control deflections in response to laser guidance inputs. Paveway II's used the same guidance system but employed larger control surfaces to improve weapon maneuvering.<sup>24</sup> Paveway III's included an improved guidance kit for low altitude employment.<sup>25</sup> Not only were control surfaces reengineered, but the flight control logic also incorporated proportional guidance. This new combination greatly improved terminal maneuvering, increasing weapon precision. Both F-111Fs and F-117s carried hard target penetrating LGBs using this improved guidance.<sup>26</sup>

Two other PGMs worthy of mention are the GBU-15 and the Maverick air-to surface missile. A two thousand pound class munition employed only by F-111Fs during Desert Storm, the GBU-15 is a glide bomb employing a datalink for steering updates.<sup>27</sup> Launched predominantly by A-10s, the Maverick can precisely target armored vehicles and artillery. Certain versions of both the GBU-15 and Maverick were day/night capable.<sup>28</sup>

Durandal and CBU-87 combined effects munition deserve mention in the unguided category.<sup>29</sup> Durandal was a French designed runway cratering device whose employment required a low level approach over the target. Following release, a parachute would stabilize the weapon pointing it downward, firing a rocket motor driving the warhead into the runway surface prior to its detonation. In the mid-1980s the USAF planned to use Durandal in NATO's OCA phase defending against a Warsaw Pact attack. Operational test and evaluation of the munition highlighted serious shortcomings and before Desert Storm the USAF was phasing it out of the inventory.<sup>30</sup> CBU-87 was considered one of the best area weapons in the inventory.<sup>31</sup> Employable from low or medium altitude, it is a cluster munition whose bomblets have an anti-armor and anti-personnel capability.

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<sup>24</sup> Paveway I/II munitions with 500, 1000, 2000 pound bomb bodies carried GBU-12, GBU-16, and GBU-10 designations respectively.

<sup>25</sup> Paveway III's are also referred to as Low Level LGBs (LLLGB).

<sup>26</sup> Certain versions of the GBU-24 and GBU-27, carried on F-111Fs and F-117s respectively, used the BLU-109 2000 pound penetrating bomb body and LLLGB guidance. Keaney and Cohen, 54.

<sup>27</sup> GBU-15s were used to destroy the oil manifolds on storage tanks to stop the dumping of crude oil into the Gulf.

<sup>28</sup> With an IR seeker both could be used at day or night, while a TV seeker gave better target resolution but restricted employment to day only.

<sup>29</sup> CBU-87 is also referred to by its acronym CEM.

<sup>30</sup> Author's personnel experience serving as an F-111E pilot in Europe, 1989-1993.

<sup>31</sup> In contrast, the USN and USMC primary cluster munition was the MK-20 Rockeye, an older munition considered less flexible and effective than CBU-87.

Technically all of the USAF fighters could employ at night and bad weather but within certain limitations. Because of their guidance kits all PGMs required clear weather to acquire or track targets. USAF F-16s did not have any targeting pods, and because of inherent bombing inaccuracies using their air-to-ground radar preferred visual delivery of unguided munitions. To deliver visually at night F-16s required an externally mounted navigation pod, of which only two squadrons in theater were equipped.<sup>32</sup> A-10s had no radar for blind bombing but could search for targets at night with their IR Mavericks, which one squadron did during Desert Storm.<sup>33</sup> However, without some other sensor providing cueing it was like looking through the proverbial soda straw.

Aircraft communication equipment came in three varieties. First were clear communications over regular radios.<sup>34</sup> Have Quick jam resistant radios contained a frequency hopping mode. For two radios to talk to each other they both needed the same frequency hopping scheme, supplied by a code known as the word of the day, and time synchronization so they could hop together. KY-58 secure radios encrypted outgoing transmissions and decrypted incoming signals. An important distinction is that while Have Quick radios are jam resistant they are not technically 'secure,' while the opposite is true for KY-58. However, interception of frequency hopping transmissions is not easy. Given Iraq's lack of technology in this area, for all intents and purposes jam resistant radios were 'secure' during Desert Storm, and much of the literature refers to it in that manner. USAF F-15s, E-3 Airborne Warning and Control System (AWACS) and suppression of enemy air defense (SEAD) aircraft came equipped with both Have Quick and KY-58 while the remaining USAF fighters had only Have Quick.

Prior to Desert Storm the USAF had refined a triad concept for tactical electronic warfare, comprised of three aircraft with specific functions.<sup>35</sup> EC-130 Compass Call aircraft concentrated on communications jamming, trying to sever links from early warning and acquisition radars to SAM target tracking radars. EF-111s would jam these radars and F-4Gs, sometimes with F-16s as additional weapon carriers, would employ high-speed anti-radiation missiles (HARM) to destroy them. The USAF SEAD philosophy was to use jamming to degrade

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<sup>32</sup> These squadrons only had LANTIRN navigation pods, not targeting pods. *GWAPS, Volume IV, Part I Weapons, Tactics, and Training*, 225.

<sup>33</sup> *Ibid*, 54.

<sup>34</sup> The three common types of aircraft radios were UHF, VHF (including FM), and HF.

<sup>35</sup> James R. Brungess, *Setting the Context: SEAD and Joint Warfighting in an Uncertain World* (Maxwell AFB: Air University Press, 1994), 40.

the enemy air defenses and force SAM radars, which relied on early warning and acquisition radars for cueing, into an autonomous mode. Without early warning inputs, the target tracking radars were forced to stay on air longer, improving the HARM's probability of kill since it needed an emitting radar to properly guide. An individual aircraft's self-protection gear carried by all USAF fighters except for the F-117 complemented this electronic combat triad.<sup>36</sup>

Important to the SEAD mission was the RC-135 Rivet Joint electronic intelligence platform.<sup>37</sup> Radars and similar equipment produce an electronic signature that not only identifies a system but can also help pinpoint its location. RC-135s served the coalition in three ways. First, they provided updates to the enemy's air defense order of battle for strike and SEAD mission planning. Second, they helped direct SEAD aircraft against potential threats, especially mobile radar SAMs. Third, they provided a data link to AWACS to help with the identification of enemy fighters.

The USAF brought a tremendous air-to-air capability in the form of its AWACS and F-15Cs. Besides agility, powerful radar, and complement of radar and IR guided missiles, the F-15C possessed two distinct methods of electronic identification.<sup>38</sup> One was an identify friend-or-foe (IFF) interrogator which could verify a friendly aircraft and the other was a non-cooperative target recognition system used to identify enemy aircraft.<sup>39</sup> AWACS also possessed an IFF interrogator.

The USAF supplied the vast majority of land based tankers with its KC-10s and KC-135s. All USAF fighters had a boom refueling system and could use a variety of jet fuels. KC-10s could refuel boom and probe equipped aircraft simultaneously and had a much larger capacity than the KC-135. In contrast, the KC-135s greatly outnumbered KC-10s, 194 to 30 by the end of the war, and had to be configured for boom or drogue operations prior to takeoff.<sup>40</sup>

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<sup>36</sup> Self protection equipment consisted of radar warning receivers (RWR), internal or external electronic counter measures (ECM) pods, and chaff and flare dispensers (also known as expendibles).

<sup>37</sup> Providing similar intelligence using similar systems on a smaller scale was the USN's EP-3.

<sup>38</sup> USN Commanders Smith and McSwain, *Desert Shield and USN Strike Planning*, December 1990, in USAF Desert Story Collection, AFHRA.

<sup>39</sup> For friendly identification the IFF interrogated a Mode IV transponder 'squawk' and for enemy identification the system is more commonly referred to as NCTR.

<sup>40</sup> *GWAPS, Volume IV, Part I, A Statistical Compendium*, 27.

## USN Air

The Navy's PGM capability differed from the USAF's in several respects, all of which affected the USN's PGM expenditures relative to the USAF.<sup>41</sup> Although most of their fighters could carry LGBs, only the A-6 could designate targets. USN LGBs included 500, 1000, and 2000 pound weapons but no hard target penetrators.<sup>42</sup> The Standoff Land Attack Missile was the USN's advanced PGM, but only seven were used in all of Desert Storm. Most LGB configurations put naval aircraft above carrier landing weight restrictions, meaning USN fighters could takeoff with LGBs but not recover back aboard the carrier with them.<sup>43</sup> When target weather was forecast to be unsuitable for PGMs, carrier commanders usually had unguided munitions loaded instead.<sup>44</sup> Thus the landing weight restriction reduced USN fighter's weapons flexibility, forcing the decision to use PGMs in questionable conditions from over the target to the carrier deck before launch. In addition, carrier magazines loaded relatively few PGMs, with carrier commanders hoarding them, probably in anticipation of the ground war or an amphibious landing. Apparently commanders were unable to access abundant LGB stockpiles on shore.<sup>45</sup> All these factors together contributed to relatively low PGM expenditures for the USN.

Because of the Navy's force structure and raid mentality its SEAD philosophy differed from the USAF. Where as the USAF brought the most dedicated electronic combat platforms to the theater, the Navy provided the largest number of HARM capable aircraft to the coalition. Due to carrier space limitations, naval aircraft must be flexible weapons platforms. As a result, Navy fighters and EA-6s all could employ HARMs, although in less accurate modes than the Air Force F-4G.<sup>46</sup> The EA-6 also serves as the Navy's tactical jammer, targeting communications, early warning, acquisition, and target tracking radars.<sup>47</sup> Tactical Air Launched Decoys and drones were used by the USN to stimulate enemy radars to improve HARM guidance. Strike packages had dedicated platforms salvo firing HARMs at known threat locations. This tactic focused on corridor clearing or specific target area suppression vice destruction.<sup>48</sup>

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<sup>41</sup> Major Rich King, Trip Report, US Navy Desert Storm Operational Debrief, 28 May 1991, 5. (Secret) Information extracted is unclassified. GWAPS TF VI-47, Folder 498, in USAF Collection, AFHRA.

<sup>42</sup> RADM Riley D. Mixson, "Where We Must Do Better," *US Naval Institute Proceedings*, August 1991, 38.

<sup>43</sup> King trip report, 5.

<sup>44</sup> Ibid.

<sup>45</sup> Ibid.

<sup>46</sup> Brungess, 96.

<sup>47</sup> Ibid.

<sup>48</sup> Ibid.

The complementary nature of the USN EA-6 and USAF EF-111 requires elaboration. Both employed the same electronic jammer, which could be fitted with different equipment or 'bands' to cover certain frequency ranges.<sup>49</sup> Because of limited high band equipment, EF-111s were normally configured to give better low band coverage, equating to better capability against early warning, acquisition, and target tracking radars of older fixed SAMs like the SA-2 and SA-3. EA-6s had better high band coverage, meaning they had more capability against Iraqi mobile SAMs like the French built Roland.

Naval air-to-air responsibilities were split between F-14s and F/A-18s. Each had only a single electronic identification capability. While the F/A-18 could determine enemy indications the F-14 could only interrogate friendly IFF.<sup>50</sup> F/A-18s employed the same radar missile as the F-15C, while the F-14 carried a longer range radar missile.<sup>51</sup> Not as good against maneuvering targets as the USAF missile, the Navy claimed a better receding target capability for its long range radar missile.<sup>52</sup> Included in the Navy's air defense arsenal is the E-2 Hawkeye surveillance and control aircraft. Smaller and less capable of wide area coverage than its USAF counterpart, the E-2 was designed for fleet support generally and point carrier defense specifically. F-14s also provided reconnaissance with an externally mounted tactical air reconnaissance pod system (TARPS). Using an optical wet film system and IR sensors, F-14 TARPS tactics and equipment emphasized low altitude operations.<sup>53</sup>

USN air-to-air refueling practices stand in stark contrast to the USAF. All Navy aircraft use a probe receptacle, consequently all Navy tankers are equipped with only a drogue system. The carrier based tanker fleet, consisting of KA-6 aircraft, is small in number and offload capacity. For safety concerns, Navy carrier commanders prefer JP-5 fuel because of its lower flashpoint.<sup>54</sup>

Carrier operations offered both advantages and disadvantages to the Desert Storm planner. Depending on the battle fleet's location, carriers had the option of moving closer to

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<sup>49</sup> ALQ-99 electronic jammer.

<sup>50</sup> Gregory M. Swider, *The Navy's Experience With Joint Air Operations: Lessons Learned from Operations Desert Shield and Desert Storm*, CRM 92-166 (Alexandria, Va.: Center for Naval Analyses, 1993), 38.

<sup>51</sup> AIM-7 Sparrow for the USAF and AIM-54 Phoenix for the USN.

<sup>52</sup> Swider, 25.

<sup>53</sup> Ibid, 47.

<sup>54</sup> Colonel Brian E. Wages, 12AF/SE, memorandum to COMUSNAVCENT/01, subject: End of Tour Report as Air Force Liaison Officer to Commander, US Naval Forces, Central Command, for Operation Desert Shield/Desert Storm, 5 March 1991, K239.0472-42, in USAF Collection, AFHRA.

target areas, which is what the Arabian Gulf carriers did during the latter half of the war. Theoretically these shorter distances could equate to more sorties and ordnance on target expended than some land based units. But the nature of orchestrating carrier launches and recoveries limited planner's flexibility in the timing of carrier sorties and reduced their output. First, catapult and launch crew manning imposed a restriction, generally limiting sustained carrier operations to 12 hours.<sup>55</sup> Second, to maximize sorties, carriers executed cyclic operations, where launch and recovery windows were carefully deconflicted.<sup>56</sup> Not a concern for autonomous carrier operations, this became a critical planning consideration when working the timing of strike packages launching from several airfields, including the carrier. Therefore planners were faced with a tradeoff between naval air sortie production and the integration of carrier and land-based strike packages. Another planning consideration was that after several days of heavy combat operations, carriers required an operational pause for replenishment of aviation fuel and aircraft ordnance.

## RAF

With the announcement of Great Britain's support for the Desert Shield coalition, the RAF quickly set about modifying its 'Operation Granby' slated air-to-ground fighters. Both Tornado and Jaguar strike aircraft received IFF transponders and jam resistant radios, while some Tornados gained handheld GPS receivers.<sup>57</sup> Jaguars were also fitted with the Sky Guardian radar warning receiver, with an improved detection feature for advanced air-to-air radars, and overwing heat-seeking missile rails, which improved self defense without sacrificing munitions carriage stations.<sup>58</sup> Jaguar pilots had started training with night-vision goggles but were not ready to use them in combat.<sup>59</sup>

Day one of the air campaign saw the RAF with no PGM capability in theater. Neither its Jaguar nor Tornados could designate for LGBs. Before Desert Storm the RAF practiced buddy lasing tactics between its Buccaneers and Tornados. Initially the RAF was told their Tornados would concentrate on runway denial missions. If shifting the Tornados to LGB missions became

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<sup>55</sup> 15 hours was the longest USN carriers sustained launch and recovery operations during Desert Storm.

<sup>56</sup> Unlike airfields, which can conduct large scale launch and recovery operations simultaneously, carriers try to conduct such operations so that launches and recoveries never overlap.

<sup>57</sup> Andy Evans, *Panavia Tornado*, (Ramsbury, England: Crowood Press, 1999), 69.

<sup>58</sup> Specifically airborne scanning Pulse Doppler radars. Andy Evans, *SEPECAT Jaguar*, (Ramsbury, England: Crowood Press, 1998), 126.



necessary, the RAF was promised buddy laser support from F-15Es.<sup>60</sup> This was an important consideration to the RAF, since it was not equipped to be expeditionary. Supporting its Tornados and Jaguars in theater was challenging enough, without adding the aging and maintenance intensive Buccaneer to the mix.<sup>61</sup>

By late January the Tornados were ready to shift to LGB missions. Unfortunately, the laser capable F-15Es were occupied with SCUD hunting.<sup>62</sup> In a matter of days the RAF introduced the Buccaneer and its associated laser designation system into theater and commenced LGB operations.<sup>63</sup> Prior to hostilities, the RAF had sped up its development of a laser designator pod for its Tornados.<sup>64</sup> This automated system represented a marked improvement over the day only, manually controlled Buccaneer designator. It was integrated into the Tornado's navigation avionics and permitted nighttime use. Laser designator equipped Tornados started flying strike missions into Iraq February 10<sup>th</sup>.<sup>65</sup>

The RAF brought a wide mix of capabilities to support to Desert Storm strike operations. RAF PGMs were all LGBs in the 1000 pound class or lower.<sup>66</sup> Its one penetrating munition, JP-233, consisted of small bomblets to crater hard surfaces, such as runways, and mines to hamper repair. An unguided munition, employment required a straight and level low altitude approach over the target. BL-755 was the RAF's primary cluster munition, similar to US versions, except that it could only be employed from low altitude. To support medium altitude counterland operations the UK purchased CBU-87 from the US.<sup>67</sup> Coincidentally, the US purchased UK produced 1000 pound bombs with time delayed fuses. They were dropped from B-52s against Iraqi fighter aircraft forward operating locations.<sup>68</sup> RAF Jaguars also carried Canadian air-to-ground rockets.<sup>69</sup> Due to its higher velocity it was considered more accurate

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<sup>59</sup> Squadron Leader Chris Plain, RAF Jaguar pilot, telephone interviewed by author, 10 May 2001.

<sup>60</sup> General Sir Peter de la Billière, *Storm Command: A Personal Account of the Gulf War* (London: HarperCollins, 1992), 87.

<sup>61</sup> Mr. Sebastian Cox, Head of Air Historical Branch (RAF), letter to author, 13 March 2001.

<sup>62</sup> de la Billière, 233.

<sup>63</sup> The Buccaneer used the PAVE SPIKE laser designator pod. Cox letter.

<sup>64</sup> Thermal Imaging/TV Airborne Laser Designator (TIALD) pod.

<sup>65</sup> Peter Binham, "TIALD – A Casebook of Cooperation," *The Hawk*, 1992, 27.

<sup>66</sup> All were Paveway I/II LGBs and none were fitted with BLU-109 penetrating bomb bodies.

<sup>67</sup> Group Captain Andrew Vallance, "Royal Air Force Operations in the Gulf," *Air Power History*, Fall 1991, 37.

<sup>68</sup> LtCol David Deptula, Chief Planner, CENTAF Special Planning Group, interviewed by GWAPS, 8 January 1992, GWAPS TF4-8-147, in USAF Collection, AFHRA.

<sup>69</sup> CRV-7 rocket.

than other rockets but not a PGM class of weapon.<sup>70</sup> Six modified Tornado tactical reconnaissance aircraft deployed with sideways looking IR and linescan systems, giving them a day/night capability.<sup>71</sup> Four Jaguars also deployed with a long range optical reconnaissance pod.

The RAF's electronic combat capability was inferior in scope to both the USAF and USN. Like the Tornado laser designator pod, the RAF accelerated development of an anti-radiation missile during Desert Shield, and six Tornados were modified to carry the missile by Desert Storm.<sup>72</sup> Over 100 such missiles were launched in the campaign, and they were designed to provide more of a temporary area suppression capability for strike packages vice specific radar destruction.<sup>73</sup> The munition's small inventory restricted employment, and the last one was launched February 13th. The RAF owned an electronic reconnaissance capability in their small fleet of specially modified Nimrod aircraft. Electronic combat considerations also dictated the Tornado's deployment to theater. UK based Tornados employed a radar warning receiver which required hardware and software changes to update. Germany based Tornados only required simpler software changes, so these were modified and sent to Saudi Arabia.<sup>74</sup>

Tornado F3 interceptors were deployed to integrate into the DCA plan. Prior to the deployment they underwent numerous upgrades including improved radar software, radar warning receivers and engine power, Have Quick radios, and improved missile capabilities.<sup>75</sup> The F3 possessed a single electronic identification function in its IFF interrogator. Still, all this could not make up for its basic design characteristics as a counter to Soviet long range bombers, resulting in less agility than other coalition fighters such as the Mirage 2000 or F-15 and enemy fighters like the Mig-29.<sup>76</sup>

RAF fighter aircraft used a probe refueling system and a modest force of 15 Victors, VC-10, and Tristar tankers.<sup>77</sup> These tanker aircraft underwent numerous modifications as well including jam resistant radios, IFF transponders, and improved defensive aids.

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<sup>70</sup> Evans, *Jagaur*, 127.

<sup>71</sup> Vallance, 37.

<sup>72</sup> The air launched anti-radiation missile (ALARM) was similar to the US HARM.

<sup>73</sup> Vallance, 37.

<sup>74</sup> An interesting side note was that since these Tornados were planned to fly from German bases to stem a Warsaw Pact offensive, their crews were not air refueling qualified. Upon arrival in Saudi Arabia they embarked on a crash checkout program, with some crews finishing their qualifications on the air campaign's first night!

<sup>75</sup> Vallance, 38.

<sup>76</sup> Cox letter.

<sup>77</sup> Air Chief Marshal Sir Patrick Hine, "Despatch: Operation Granby," *Second Supplement to the London Gazette*, 28 June 1991, G40.

## FAF

Much of the story regarding French Air Force strike capabilities revolves around what was not deployed to theater. Designating ability resided in an externally mounted laser pod, which used a TV camera for day acquisition and an IR imager for night.<sup>78</sup> It could be mounted on all the French aircraft deployed—the Mirage 2000, Jaguar, and F1-CR. Exclusively used on the French Jaguars was a French made laser guided air-to-surface missile.<sup>79</sup> With a 240Kg warhead it was a hard target penetrating PGM with supposed more standoff and effectiveness than the Maverick.<sup>80</sup> USAF planners were duly impressed by the weapon, but its inventory was limited.<sup>81</sup> Estimates range between 150-180 rounds in stock, with an additional 55 ordered just before the war.<sup>82</sup> The French also built the Matra series LGB system, used with 250, 400, and 1000 Kg bomb bodies. However, French LGBs saw only limited use late in the war.<sup>83</sup> French weapons inventory included Durandal which was not used for reasons already stated.

French aircraft had very specific roles despite their multipurpose capabilities. The Mirage 2000s came from air defense units and were used strictly in air-to-air role. The only jam resistant radio equipped deployed French fighter, Mirage 2000s could interrogate friendly IFF but not identify enemy aircraft.<sup>84</sup> Jaguars were the primary ground attack aircraft, although they were sometimes fitted with a reconnaissance pod.<sup>85</sup> Its navigation system's error potential combined with a lack of radar altimeter made it unsuitable for nighttime operations.<sup>86</sup> To compensate, French pilots fitted their jets with hand held GPS receivers, mounted in the cockpit via velcro, but the aircraft still only flew day sorties.<sup>87</sup> The F1-CR, a reconnaissance version of the Mirage F-1, served in the ground attack and tactical reconnaissance roles. With more accurate navigation gear than the Jaguar, its reconnaissance kit consisted of optical, IR linescan,

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<sup>78</sup> ATLIS II. Duncan Lennox and Arthur Rees, ed., *Jane's Air-Launched Weapons (JALW)*, (Coulsdon, Great Britain: Jane's Information Group, 1990), Issue 11.

<sup>79</sup> AS-30L. Ibid.

<sup>80</sup> Jolyon Howarth, "French Policy in the Conflict," in *International Perspectives*, 187-8.

<sup>81</sup> LtCol Deptula described the weapon as "really awesome." Deptula interview, 8 January 1992.

<sup>82</sup> Evans, *Jaguar*, 140.

<sup>83</sup> Ibid, 143.

<sup>84</sup> Major Didier Paquet, French Air Force, interviewed by LtCol Christopher Haave, USAF Foreign Exchange Student, French Joint Defense College, 9 April 2001.

<sup>85</sup> Evans, *Jaguar*, 147.

<sup>86</sup> Rod Alonso et. al., "The Air War," *Military Lessons of the Gulf War*, ed. Bruce Watson et. al. (Novato: Presidio Press, 1991), 100.

<sup>87</sup> Holwarth, 187. and Evans, *Jaguar*, 142.

and side-looking airborne radar systems.<sup>88</sup> C-135FR tankers deployed to support the probe equipped French fighters.<sup>89</sup>

France's most capable air-to-ground machine, the Mirage 2000N, stayed home for political reasons.<sup>90</sup> A two seat aircraft with terrain following radar, laser designating pod, and significant air-to-air capability, it also served as France's primary manned nuclear weapon delivery system. In addition to the incremental nature of the French commitment to the coalition, post war analysts assert that this association with the nuclear mission led Mitterand to keep this aircraft out of Desert Storm.

## **RSAF**

Saudi Arabia relied on their western allies for weapons procurement, and its air order of battle consisted of both American and British equipment.<sup>91</sup> F-5F two seat aircraft provided laser designation with a rear cockpit mounted manual tracker.<sup>92</sup> These aircraft could buddy lase for RSAF Tornado IDS jets in a benign threat environment during the day only.<sup>93</sup> RF-5Es provided reconnaissance with optical cameras and IR linescanners. Munitions inventory included British JP-233 and American 500 and 2000 pound LGBs, air-to ground missiles, and a variety of unguided weapons.<sup>94</sup> Except for JP-233 there were no penetrating weapons in the inventory.

For air defense the Saudis employed E-3 AWACS, F-15Cs and Tornado ADV fighters. While similar in aerodynamic performance, for political reasons US aircraft are sold to the RSAF with downgraded avionics. RSAF F-15Cs had Have Quick radios but not secure KY-58 radios, limited IFF interrogation ability, and degraded internal electronic jamming as well.<sup>95</sup>

All RSAF fighters are air refuelable, but like the US use both boom and probe systems. The Saudis maintain a fleet of E-3, boom, and KC-130s, drogue, to meet the refueling needs of its mixed fighter force.

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<sup>88</sup> Christopher Chant, *Encyclopedia of Modern Aircraft Armament*, (Wellingborough, England: Patrick Stephens Limited, 1988), 101.

<sup>89</sup> France also deployed a small number of C-160 electronic intelligence aircraft. Mission details remain classified, but these aircraft probably supported the French's building of their own Iraqi electronic order of battle.

<sup>90</sup> Holwarth, 187.

<sup>91</sup> Air-to-ground RSAF Tornados carried the label 'IDS' while air-to-air versions were labeled 'ADV.'

<sup>92</sup> The AVQ-27.

<sup>93</sup> Chant, 216.

<sup>94</sup> US supplied PGMs included Paveway I/II LGBs and Mavericks.

<sup>95</sup> Data derived from author's personal conversations with allied pilots.

## **Gulf States (minus Saudi Arabia), Canada, Italy**

The information presented here is not as complete as that supplied previously but helps round out the entire allied picture.

Kuwait contributed the most sorties out of this group with its A-4 and F-1 aircraft. Kuwaiti A-4s did not have radar warning gear and although fitted with air refueling probes, their pilots were not comfortable in that skill and requested missions not requiring it.<sup>96</sup> That country's F-1s had experienced maintenance problems and relatively poor support from their French suppliers. The F-1's air-to-air radar was considered unreliable, relegating it like the A-4 to a day only air-to-ground role.<sup>97</sup> F/A-18s on order were not scheduled for delivery until July 1992 due to US congressional restrictions.<sup>98</sup>

In March 1990 Bahrain accepted the first of their new block 40 F-16 aircraft, comparable to their US counterparts with similar radar warning and self-protection systems. The literature suggests the 12 aircraft package included navigation and targeting pods, but these apparently were not used as the jets only flew air-to-air missions.<sup>99</sup> Like the Saudis, the Bahrainis operated the F-5 in a ground attack role, probably minus the manual laser tracker.

In terms of numbers of sorties, the smallest contributors to the coalition were the UAE and Qatar. The UAE flew the Mirage 2000 in a ground attack role. The original order to Dassault specified that the aircraft must be capable of firing US made weapons. When the first batch of 18 were delivered in 1987, much to the unpleasant surprise of the UAE the aircraft matched only French specifications. To placate its customers Dassault offered to deliver the remaining aircraft in the same condition and then modify them on location.<sup>100</sup> Research could not uncover if these modifications took place before Desert Storm. Qatar's F-1s offered a non air refuelable ground attack capability to the coalition.<sup>101</sup>

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<sup>96</sup> Thomas Keaney and Wayne Thompson, Trip Report, Visit to Saudi Arabia and Kuwait, 9-16 July 1992, 11 and 21. GWAPS NA-377, in USAF Collection, AFHRA.

<sup>97</sup> Anthony H. Cordesman, *Trends in the Military Balance and Arm Sales in the Southern Gulf States After the Gulf War: 1990-1993*, (Washington, D.C.: Center for Strategic and International Studies, 1998), 96.

<sup>98</sup> Ibid.,

<sup>99</sup> LANTIRN navigation and targeting pods. Hugh Lucas, "USA confirms F-16 sale to Egypt, Bahrain," *Jane's Defence Weekly* 7, no 5 (7 February 1987): 171.

<sup>100</sup> Jacques Isnard, "UAE to resolve Mirage 2000 dispute," *Jane's Defence Weekly* 8, no 22 (5 December 1987): 1302.

<sup>101</sup> 614<sup>th</sup> Tactical Fighter Squadron, Desert Shield/Desert Storm AAR, 27, K-SQ-FI-612-HI, in USAF Collection, AFHRA.

Two NATO countries each contributed a single fighter squadron. Canada sent CF-18s and one drogue fitted air refueling aircraft. Like their USN brethren these aircraft lacked Have Quick radios. Just before the war CF-18s were fitted with Link-4, a first generation data link system that tied into the USN's surface and airborne surveillance radars.<sup>102</sup> Italy deployed its ground attack Tornados, built to the same specifications as RAF and RSAF versions. However, for multiple reasons these jets were restricted to only unguided general purpose bombs.<sup>103</sup> Problems on opening night, where only one of the eight aircraft managed to refuel and then was subsequently shot down, led to a change in tactics. The Italians chose to buddy refuel, launching eight Tornados a night to get four across the target.<sup>104</sup>

Overall, these countries made a modest contribution to the coalition. Together Canada and Bahrain flew 6% of the DCA sorties with their CF-18 and F-16 aircraft. This group also accounted for 3% of interdiction sorties, the bulk flown by Kuwait.<sup>105</sup> As for avionics, their capabilities varied considerably, but none were LGB capable nor had jam resistant or secure radios.

## Summary

Capabilities varied across the coalition, representing more of a continuous spectrum than clear-cut tiers. Regarding laser designators and PGMs, the big five had both, with major differences in munitions. Two USAF aircraft could self-designate the coalition's only penetrating LGBs, and by far the USAF enjoyed the largest PGM inventory. The USN had only one designating platform and PGM inventory challenges. The RAF made the greatest effort to develop and exploit its PGM capability, and had a larger inventory than the other allies combined.

In night vision or attack capability both the USAF and USN held an advantage. All US PGM carriers could employ weapons at night, although A-10s were somewhat limited. Terrain following radar and good radar blind bombing systems gave allied Tornados a night all weather bombing capability, and by the end of the war the RAF progressed from day only LGB strikes to

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<sup>102</sup> Major Jean H. Morin and Lt-Commander Richard H. Gimblett, *Operation Friction: The Canadian Forces in the Persian Gulf* (Toronto: Dundurn Press, 1997), 171.

<sup>103</sup> The aircraft were not fitted with any laser designation equipment and both cluster munitions and JP-233 were not part of the Italian weapons inventory. Evans, *Tornado*, 71.

<sup>104</sup> Ibid, 75

<sup>105</sup> GWAPS, Volume V, Part I, *A Statistical Compendium*, 232-3.

day and night operations. Despite the French laser designator pod's day/night versatility, aircraft deployment choices restricted missions to day only. Most of the older allied fighters were best suited for daylight bombing as well.

Aircraft communication systems differed greatly, especially between the USAF and USN. All USAF aircraft had Have Quick while the allies were evenly split. However, most USN platforms were not Have Quick equipped. KY-58 secure radios resided in US electronic combat platforms, AWACS, and dedicated US air-to-air fighters like the F-15 and F-14.

The US brought the vast majority of electronic combat gear to the war. Whereas the USAF had more dedicated electronic combat platforms, the USN had more HARM shooters, albeit all less capable than the USAF's F-4G. The RAF owned a limited stock of the coalition's only other anti-radiation missile. All US fighters and most major allies had self-protection systems in the way of radar warning receivers and electronic countermeasures.

Rounding out capability differences, most coalition fighters, save some of the Gulf States, had IFF transponders. Only the USAF F-15Cs had a dual electronic identification capability to identify both the presence of enemy and absence of friendly aircraft. Tactical reconnaissance assets were sprinkled throughout the coalition, although the USAF RF-4Cs comprised the majority. For air refueling RSAF F-15s and all USAF fighters employed a boom receptacle while all others used a probe. The USAF brought the majority of tankers to the Gulf, able to go both ways to service this mixed fleet.

## **Chapter 3**

### **PREPARATION**

*Multinational force [MNF] participation is important and can provide valuable military and political contribution to campaign . . . We would assume the campaign will not depend on MNF participation for its success.*

Checkmate Draft Memo to Black Hole, August 1990

#### **Introduction**

Those who fought Desert Storm had a luxury rarely afforded combatants—five months dedicated to focused training and planning for the war. The United States and its allies participated in multinational flying training prior to the Iraqi invasion and, combined with the dedicated Desert Shield training, were able to mitigate several capability differences at the tactical level. Air campaign planning evolved throughout Desert Shield. In five months three different groups merged two conceptual air campaign plans attempting to best integrate the various capabilities of the coalition. As a result of their efforts the CFACC started the air war with two days worth of Air Tasking Orders (ATO), day three's Master Attack Plan, and a clear concept for the rest of the campaign.

#### **Combined Flying Training**

Prior to Desert Shield, combined tactical flying training for Desert Storm participants consisted of USAF 'Flag,' Central Air Force (CENTAF), United States Air Forces Europe, and Allied Air Forces Central Europe sponsored exercises. While all four



served the coalition well, US and allied pilots consistently rated Flag exercises, especially Red Flag, as the best preparation for Desert Storm.<sup>106</sup>

Red Flag exercises took place three to four times a year at the Nellis Range complex in southern Nevada, over desert terrain similar to that in Southwest Asia.<sup>107</sup> Although dominated by US units, there was a fair amount of allied participation. In 1989 all of the major Desert Storm coalition air forces except the RSAF flew in Red Flag exercises. Green Flags were held only once a year and concentrated on integrating electronic combat assets into strike packages. Because of the classified nature of some of these systems participation was restricted to US units only.

Red Flag exercises are designed for the specific purpose of simulating an aircrew's first ten combat missions. Therefore the whole exercise revolves around realistic tactical training of aircrews. Not only do crews fly multinational aircraft packages against simulated integrated air defenses, but planning, briefing, debriefing, and mission reconstruction are done face-to-face to facilitate learning. This format allows flyers to gain an appreciation for others air force's capabilities and strengths and weaknesses, as well as disseminate flying tactics.<sup>108</sup>

Desert Shield bested Red Flag in that it provided a host of coalition units the collective opportunity to focus on an actual and proximate threat. USAF units were spread all over Saudi Arabia and the other Gulf States which allowed USAF aircrews to interact daily with most of the allies on a personal level. US and allied units would each host tactics and capability conferences. In their after action report one of the USAF's dedicated SEAD units claimed these mutual information exchanges enabled them "to better integrate with offensive strike packages so they could provide better support" and "made other units more aware of the F-4G's capabilities and decreased coordination problems."<sup>109</sup>

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<sup>106</sup> *Gulf War Air Power Survey (GWAPS), Volume IV, Part I, Weapons, Tactics, and Training* (Washington, D.C.: US Government Printing Office, 1993), 18 and Mr. Sebastian Cox, Head of Air Historical Branch (RAF), letter to author, 13 March 2001.

<sup>107</sup> Four Red Flag exercises were conducted in 1989, while Desert Shield curtailed 1990 exercises to only three.

<sup>108</sup> While Red and Green Flag exercises focus at developing tactical flying proficiency, Blue Flag exercises concentrate on operational level air campaign planning and execution.

<sup>109</sup> Charles I. Starr, *History of the 35th Tactical Fighter Wing (Provisional): Operations Desert Shield and Desert Storm (U), Volume I*, 14 April 1992, (Secret) Information extracted is unclassified. GWAPS NA-277, in USAF collection, AFHRA.

Combined flying training during this period consisted of dedicated air-to-air and close air support/battlefield air interdiction training, weekly large force exercises, and strike package commander training. Aircrews were able to brief, fly and then debrief their sorties as entire packages vice individual squadron formations, sometimes face-to-face. In late October CENTAF conducted a flying exercise involving nearly every flying unit in theater. US and Saudi control centers were linked by US and Saudi AWACS and communications connectivity was demonstrated throughout the theater. Afterwards planners felt more confident that airborne coordination of a massive air campaign was possible.<sup>110</sup>

Individual units used Desert Shield to resolve some interoperability issues before the shooting started. RAF Tornado's modified radar warning gear had not been tested against friendly jamming aircraft before their deployment. The USN accommodated the RAF with EA-6 sorties as well as hosting Tornado aircrew aboard one of their carriers. Exercises also gave the RAF a chance to familiarize themselves with their newly installed Have Quick jam resistant radios.<sup>111</sup>

General Horner insisted that all air training in Saudi airspace be on the training ATO. For most of the allied air units this meant beginning the important process of coalition building at the tactical level in addition to solidifying the concept of General Horner as the CFACC. But USN carrier operations were split. The Red Sea Battle Fleet participated fully in the Desert Shield training ATO and flying exercises. However, most of the Arabian Gulf Battle Fleet arrived just prior to or during hostilities, with the USS Midway as the lone exception.<sup>112</sup> Aircraft from the Arabian fleet present for Desert Shield trained over the Gulf of Oman and did not require inclusion in the training ATO.<sup>113</sup> This dual nature of carrier air would permeate the entire planning and execution of the air campaign.

General Horner acknowledged the value of Desert Shield in his CENTAF Desert

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<sup>110</sup> *GWAPS Volume II, Part II, Command and Control*, 98.

<sup>111</sup> RAF Wing Commander Steve Cockram, Air Command and Staff College, letter to author, subject: RAF's Role in Desert Shield/Storm, 15 February 2001.

<sup>112</sup> Gulf War literature refers to the same body of water as either the Arabian or Persian Gulf. Host nation sensitivities are responsible, since Saudi Arabia only acknowledges the moniker Arabian Gulf. Primary source material favors the term Arabian and that convention is used here.

<sup>113</sup> Peter P. Perla, *Desert Storm Reconstruction Report (U), Summary (U)* (Alexandria, Va.: Center For Naval Analyses, 1991), 54. (Secret) Information extracted is unclassified.

Storm After Action Report: “coalition equipment problems and doctrine offset by common training and good FMS [foreign military sales] program.”<sup>114</sup> A Saudi F-15 squadron commander summarized Desert Shield’s role another way: “we did not train, we rehearsed!”<sup>115</sup>

## Planning

The final Desert Storm air campaign plan broke down into four phases. Phase one, “Strategic Air Campaign,” listed no specific objectives. Its goals included “destroying” the Iraqi’s leadership and military command and control, attriting the Republican Guard, and attacking strategic air defense and airfields. Phase two, “Air Supremacy in the KTO,” was designed to create a threat free environment to allow unhindered operations in the KTO. In phase three, “Shaping the Battlefield,” planners wanted to interdict supply to Iraqi fielded forces and reduce their combat capability by 50%, preparing for offensive ground operations to liberate Kuwait. During phase four, “Air Support to Ground Operations,” coalition air was to aid in the destruction of the Republican Guard by cutting off its retreat, thereby creating a killing zone in Kuwait.<sup>116</sup> Allied air figured differently in each of these phases.

Planning began as two somewhat independent efforts. “Instant Thunder” was the name Colonel John Warden gave to the strategic air campaign devised by his USAF staff agency, Checkmate. Warden hoped that Instant Thunder’s attack against 48 targets in Iraq would compel Saddam Hussein to withdraw from Kuwait. Checkmate was an USAF organization with some sister service representation but no allied presence. Because allied participation was unknown in early August, at the time of Instant Thunder’s inception, only US assets were included.<sup>117</sup> With increased allied involvement a knowledge of allied capabilities was required for inclusion into the plan.

US Central Command (CENTCOM) provided the other primary input into the air campaign planning process. CENTCOM Plan 10020-90 was the standing concept

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<sup>114</sup> General Horner was referring to the sale of US equipment to Gulf allies. LtCol Laird, memorandum to LtCol Harvey, subject: Trip Report notes – CENTAF/TAC (13-14 Aug 91). (Secret) Information extracted is unclassified, GWAPS NA-132, in USAF Collection, AFHRA.

<sup>115</sup> Colonel Mike Kiraly, memorandum to GWAPS, subject: Saudi/Kuwait Trip – 8-16 July 92, 21 July 1992, GWAPS NA-377, in USAF Collection, AFHRA.

<sup>116</sup> Summary of air campaign phases and objectives taken from *GWAPS Volume I, Part I, Planning*, 5-6.

regarding defense of Saudi Arabia. CENTCOM's staff, including CENTAF commander Lieutenant General "Chuck" Horner, exercised this plan in the June 1990 "Internal Look" command post exercise.<sup>118</sup> Typical of standing unified command plans was 10020-90's lack of reliance on allied military forces for success. Since such coalition support was considered questionable and situation-dependent, plans acknowledged its inclusion for political effect but did not count on it. Like all US command post exercises, Internal Look included only US players and served to reinforce this US only framework.<sup>119</sup> From the outset both planning efforts saw allied air forces as peripheral.

Warden's Instant Thunder briefing to General Horner and the briefing's aftermath effectively centralized the planning process. CENTAF in Riyadh became the lead planning agency, with the growing resources of Checkmate filling an information gathering support role. But the CENTAF forward's organization would continue to perpetuate a somewhat divided planning effort.

What became known as the "Black Hole" was originally CENTAF's offensive planning cell under Lieutenant Colonel Dave Deptula, who had been a member of Warden's Instant Thunder planning team. With Instant Thunder and CENTAF's previous efforts as a starting point, Deptula developed an offensive air campaign against Iraq. Early in Desert Shield, with all the intense diplomatic maneuvering, offensive planning was politically sensitive and resulted in stringent operational security measures applied to the Black Hole. By September the Black Hole group numbered 29, including two USN and two USMC representatives and one each from the US Army and RAF. By November ten more had been added, including one RAF and two RSAF officers.<sup>120</sup> The two USN planners represented six carriers and were assigned from each fleet. Since previously mentioned political considerations limited French air forces to employment in Kuwait or in support of their own ground troops, they were not included in Black Hole planning. Several weeks before execution they were partially included in the Black Hole effort but never had a planner assigned to Deptula's group. Deptula and his group

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<sup>117</sup> *Ibid.*, 124.

<sup>118</sup> CENTAF participation took place at the same facilities used for Blue Flag exercises.

<sup>119</sup> *GWAPS Volume I, Part I, Planning*, 47.

<sup>120</sup> *GWAPS Volume I, Part II, Command and Control*, 165.

believed their understanding of allied capabilities and ability to fold them into the plan compensated for the lack of other air force subject matter experts.<sup>121</sup>

Contrasting this secretive effort was Lieutenant Colonel Sam Baptiste's defensive planning cell, which was more politically acceptable since it meshed with the defensive posture of Desert Shield. Kept separate, the defensive cell was vaguely aware of the offensive efforts in the Black Hole. Baptiste himself was not given access until immediately before the air campaign began. Focused on the defense of Saudi Arabia, planning took on an "airland battle" flavor and was open to all coalition members.

In December General Horner reorganized the air planning effort, joining the offensive and defensive planning cells under the rubric of "Guidance, Apportionment, Targeting (GAT)" in CENTAF's Campaign Plans division, led by Brigadier General "Buster" Glosson. But for these two cells nothing really changed. The offensive cell was simply renamed the Iraqi Cell and the defensive cell became the KTO cell. Both remained separate entities under GAT, each producing master attack plans later merged into one ATO. The different natures of their planning efforts perpetuated an 'A' and 'B' team mentality, reinforced by the continued operational security concerns.<sup>122</sup> Deptula had responsibility for phase one of the air campaign, while Baptiste was relegated to coordinating phases two through four. The overwhelming USAF presence in the Black Hole combined with compartmentalization of the planning effort reduced interaction between the Iraqi cell, CENTCOM and its component staffs.<sup>123</sup>

As a military solution appeared more likely, President Bush authorized the deployment of additional combat power to the theater. This "overabundance of air power" allowed phases one, two, and three to start almost simultaneously, and gave planners more latitude in resource allocation.<sup>124</sup> Below details specific integration of coalition air forces into the air campaign's four phases.

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<sup>121</sup> LtCol David Deptula, Chief Planner, CENTAF Special Planning Group, interviewed by Thomas Keaney, Mark Mendeles, Williamson Murray, Barry Watts, GWAPS staff, 20 December 1991 – 2 January 1992. (Secret) Information extracted is unclassified. GWAPS TF4-8-147, in USAF Collection, AFHRA.

<sup>122</sup> *GWAPS Volume I, Part I, Planning*, 229.

<sup>123</sup> *GWAPS Volume I, Part II, Command and Control*, 171.

<sup>124</sup> *GWAPS Volume I, Part I, Planning*, 102.

## Phase 1

Mostly USAF assets were tasked against phase one target sets, minus airfields, which included hardened point targets in populated and sometimes heavily defended areas. The combination of stealth and penetrating PGMs made the F-117 the weapon of choice for most of these targets. Later in the campaign, with Iraqi air defenses degraded, planners believed non-stealthy platforms like F-16s could deliver unguided munitions with sufficient accuracy against non-hardened targets in the Baghdad area.

Planners had several options regarding airfield attacks. One was to use the American CBU-89, an anti-personal and anti-armor cluster mine, to deny or impede access to the runways. This approach had two drawbacks. First, tests in the mid-1980s showed that CBU-89 experienced a high failure rate when dropped above several hundred feet against concrete surfaces. Another problem was that on a flat surface, such as a runway, it was relatively easy to clear with high-pressure water hoses.<sup>125</sup> A second option was to use general-purpose bombs to crater runways, making them unusable. Well-constructed runways would have required penetrating bomb bodies.<sup>126</sup> Some planners suggested penetrating bomb attacks followed by CBU-89 drops. Instead, planners turned to JP-233, which combined both of these features into one munition.

Airfield attacks included RAF and RSAF Tornados carrying JP-233s. Planners realized that Iraqi airfields were too big and numerous for the available Tornado assets to shut down the runways. Instead, JP-233 strikes were designed to introduce "friction" into Iraqi fighter operations.<sup>127</sup> Taxiways leading from the Iraqi hardened aircraft shelters (HAS) were targeted rather than the runways themselves, which trapped aircraft in their shelters or at least hindered takeoffs. Planners also dropped British 1000 pound time delay bombs from B-52s on Iraqi forward operating locations to hamper dispersal efforts.<sup>128</sup> With JP-233s planners could conserve penetrating PGMs for more pressing targets, along with the PGM capable aircraft needed to employ them. Because of their integration into this phase the British and Saudis required access to Black Hole planning.

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<sup>125</sup> The bomblets are shaped like oversized hockey pucks and water hoses would send them scooting along runways without detonating.

<sup>126</sup> Due to ricochet, broaching, and bomb body break up upon impact, general purpose bombs are unsuitable for thick or reinforced concrete structures.

<sup>127</sup> Cox letter.

As noted earlier, French Air Force participation was questionable until just before the start of the air campaign, when their government authorized attacks into Kuwait only. Because of this and Jaguar range limitations LtCol Deptula had to find phase one targets close to their base. He was able to match their laser guided air to surface missiles against hardened SCUD shelters at a Kuwaiti airbase on day one.<sup>129</sup> Day two had French Jaguars scheduled to strike surface-to-surface anti-ship missiles sites and logistics centers, with more attacks on logistics center scheduled for day three.

Air refueling proved a planning constraint affecting strike packaging. USN strike aircraft required air refueling but planners had trouble juggling KC-135 configurations against the predominant needs of boom versus probe aircraft. Not only did the RAF tankers have excess capacity off their drogue tankers, but their strike packages also required additional SEAD support beyond their anti-radiation missile equipped Tornados. These needs and the proximity of RAF bases to the coast made the packaging of USN SEAD assets with RAF strike aircraft and tankers a good fit.<sup>130</sup>

SEAD was an area that bridged phases one and two. Planners thought the Iraqi IADS in both theaters had to be neutralized before most coalition aircraft could attack with low losses.<sup>131</sup> The SEAD strategy was to destabilize the IADS with an initial big effort and keep it that way. Overall the SEAD plan required a complete integration of the various USAF and USN capabilities. F-117s functioned as important SEAD assets by destroying command and control nodes and critical radars to help blind the IADS. USN Tomahawk missiles were used as well against fixed nodes. Decoys were launched to stimulate enemy radars, making them more susceptible to HARMs, especially those from USN shooters firing in a preprogrammed mode. RAF SEAD missions, in limited numbers, were integrated into both RAF and US strike packages providing direct support. With the majority of radar SAMs destroyed or suppressed, plans called for strike aircraft (besides F-117s) attacking from medium altitude. Planners believed that the demonstrated low altitude accuracy of advanced aircraft such as the F-16 would transfer to medium altitude.

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<sup>128</sup> LtCol David Deptula, Chief, CENTAF Special Planning Group, interviewed by GWAPS, 8 January 1992. (Secret) Information extracted is unclassified. TF4-8-147, located in USAF collection, AFHRA.

<sup>129</sup> Ibid.

<sup>130</sup> Cockram letter.

## Phase Two

While planning the air offensive, coalition fighters maintained DCA patrols as part of Desert Shield. Both General Horner and Saudi commander General Khaled bin Sultan believed this task was made easier since the coalition fell into an established air defense system, comprised of US-made RSAF AWACS and F-15s, making it simple to integrate additional assets.<sup>132</sup> When US AWACS arrived, they were positioned forward along the border with Saudi AWACS flying back in a “goalie” orbit. Differences between US and RSAF doctrine of AWACS employment required this arrangement.<sup>133</sup> The Saudis saw AWACS as a strategic asset dedicated to homeland surveillance and RSAF crews were not familiar with managing tanker orbits, strike packages or directing combat air patrols (CAP). In the goalie orbit the Saudi AWACS performed the important function of airborne datalink for the forward AWACS, giving the operations center in Riyadh the entire air picture.<sup>134</sup>

A major factor in the DCA plan was the promulgation of air-to-air rules of engagement (ROE). To avoid fratricide fighters could employ missiles beyond visual range only when there was: presence of enemy indications, absence of friendly indications, and clear field of fire. Hostile intent is an important determinant of the ‘enemy’ criteria, and a difference of opinion on this point between two coalition partners caused some friction in the Desert Shield DCA plan.

Intent is a relatively simple matter during hostilities, since any aircraft identified as an Iraqi was assumed hostile. But it was a much trickier business during Desert Shield because no one wanted to precipitate conflict. The British government took a very restrictive approach, instructing their aircrews that only threatening actions such as Iraqi air-to-air radar lock-on constituted hostile intent.<sup>135</sup> The USAF view was more liberal,

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<sup>131</sup> *GWAPS Volume I, Part I, Planning*, 150.

<sup>132</sup> Lieutenant General Charles Horner, Commander, US Central Air Forces, address to the Order of Dadaelians, (place not given), 11 September 1991, 9. GWAPS TF6-47-539 in USAF collection, AFHRA and HRH General Khaled bin Sultan with Patrick Seale, *Desert Warrior: A Personal View of the Gulf War by the Joint Forces Commander* (New York: HarperCollins Publishers, 1995), 338.

<sup>133</sup> Colonel Mark Winstel, Director, Engineering and Tests Electronic Combat, interviewed by Robert Mandler, Historian, USAF Air Warfare Center, 21 December 1991, 29.

<sup>134</sup> *Ibid*, 8.

<sup>135</sup> General Sir Peter de la Billière, *Storm Command: A Personal Account of the Gulf War* (London: HarperCollins, 1992), 175.



with aircrews able to exercise judgment in determining if an Iraqi aircraft's actions or flight path represented hostile intent. For this reason, Horner was never comfortable with RAF air-to-air Tornados on Desert Shield DCA patrols since he believed they were taking unnecessary risks.<sup>136</sup>

With the transition from Desert Shield to Desert Storm, the counterair plan called for USAF F-15C DCA patrols to push forward, practically over the Iraqi air defense fighter bases. From these positions they could work in concert with the airfield strike packages to quickly neutralize the Iraqi air threat. According to USAF planners, the F-15C was the logical choice for this mission because of its optimized air-to-air radar, weapons load, and dual electronic identification capabilities. The USN disagreed, with their Black Hole planners claiming that the ROE favored the USAF F-15C's avionics and discriminated against USN fighters.<sup>137</sup> General Horner said this issue was the only major disagreement he had with USN Central Command (NAVCENT) Commander Admiral Arthur, and that they both took their case to General Schwarzkopf who agreed with the original plan.<sup>138</sup> Integral to this DCA plan was the number of coalition fighters available for border defense, allowing the F-15Cs to patrol forward. The Arabian fleet formed a barrier defense against any attacks from Iran, and Saudi F-15Cs, Mirage 2000s, CF-18s, and Bahraini F-16s formed DCA patrols along the coalition's periphery. Even the RAF air-to-air Tornados, relegated to protecting orbits of support aircraft such as AWACS, Rivet Joint, and tankers, relieved other more capable coalition fighters from performing this duty.<sup>139</sup>

### **Phases Three and Four**

Because of the emphasis on phase one during Desert Shield, phases three and four were mostly conceptual and never articulated in a detailed plan.<sup>140</sup> Planners envisioned shifting F-111Fs and F-15Es from phase one to three quickly as phase one targets were

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<sup>136</sup> *Ibid.*

<sup>137</sup> USN Commanders Smith and McSwain, *Operation Desert Storm JFACC Special Planning Cell Review*, Desert Story Collection, K239.0472-42, 18, in USAF Collection, AFHRA.

<sup>138</sup> Horner Daedalian speech, 8.

<sup>139</sup> These platforms are known as High Value Airborne Assets (HVAA) and such duty is referred to as HVAA CAP. Cox letter.

<sup>140</sup> LtCol Sam Baptiste, Chief, KTO Cell, interviewed by Dianne Putney and LtCol Richard Reynolds, College of Aerospace Doctrine, Research and Education, 24 September 1992, 42, K239.0472-72, in USAF Collection, AFHRA.

eliminated.<sup>141</sup> These aircraft were slated for attacks against bridges in the interdiction effort, although it was thought that coalition aircraft like F-16s and F/A-18s dropping unguided munitions from medium altitude would also be effective against these targets. Additional assets deploying to theater in December and January allowed planners to assign large numbers of F-16s and A-10s to start phase three operations immediately.<sup>142</sup>

The dedication of allied air, minus RAF and RSAF Tornados, to the KTO as part of phase three can be attributed to four reasons. First, most of the allied aircraft, in addition to many US aircraft, carried only unguided general purpose and cluster munitions. These were better suited to the targets presented by the Iraqi fielded forces in the KTO, not only because of target type, but also because of the location of the targets in sparsely populated areas which practically eliminated collateral damage concerns.<sup>143</sup> Second, limited air refueling resources as a whole and limited air refueling capability of most the gulf state air forces made KTO targets more accessible. Such air refueling considerations combined with carrier positioning caused USN strikes to concentrate on targets near the Iraqi border and in the KTO. Third, KTO targets were politically more acceptable for some of the allies. As with the initial French air efforts, Gulf States' attacks in Kuwait were as limited to the expulsion of Iraq from Kuwait vice threatening Iraq itself. Finally, the lower surface-to-air threat presented by the KTO suited most Gulf States' limited self-protection systems.

Coalition employment of their F-1s was affected by Iraq's operation of the same French built aircraft. Because of their long range sideways looking radar system, during Desert Shield French F1-CRs flew tactical reconnaissance missions mapping Iraqi ground positions.<sup>144</sup> Since French F1-CRs could accomplish this task while remaining south of the border, they did not present an identification problem for coalition DCA patrols, who were defending against Iraqi aircraft penetrating Saudi airspace from the north. No longer the case when the air campaign started with coalition aircraft flying to and from the KTO and Iraq, initially all coalition F-1 aircraft were grounded to prevent

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<sup>141</sup> *GWAPS Volume I, Part I, Planning*, 186.

<sup>142</sup> *Ibid.*

<sup>143</sup> *GWAPS Volume II, Part II, Effects and Effectiveness*, 98.

<sup>144</sup> Stan Morse, *Gulf Air War Debrief*, (Westport, Conn: Airtime Publishing, Inc., 1991), 34.

fratricide. Their future use was contingent on the neutralization of the Iraqi air threat, specifically their F-1s.

## **Summary**

A combination of factors minimized the effect of capability differences on air campaign planning. First, the coalition enjoyed the luxury of five months to train, improve other air forces proficiency, and revise the air plan. Second, the end of the cold war allowed deployment of significant airpower to the theater. Planners could assign aircraft to a wide variety of tasks based on appropriate aircraft and weapon combinations without running into serious resource constraints. Third, the USAF dominated the CFACC command structure, brought the most capable aircraft to the conflict, and ran the central planning group, the USAF Black Hole. Because of the overwhelming amount of US airpower, Black hole planners did not have to rely on other air forces. They first planned with USAF assets, integrating some other niche capabilities (e.g. Navy Tomahawk missiles and radar decoys, RAF/RSAF JP-233 runway denial missions) and then filled in other air forces as needed. Fourth, two distinct theaters, differing in threat level, target types, and distance from coalition bases allowed planners to match aircraft capabilities and host nation desires to suitable target sets. The unity of effort created by the Black Hole's emphasis on targets in Iraq facilitated this segmented planning mindset. With the Black Hole emphasis on phase one, it was natural for planners to put the more capable aircraft here while assigning the majority of non-US fighters to the KTO.

Finally, although PGMs were emphasized during Desert Shield planning, planners assumed advanced coalition fighters could employ unguided munitions from medium altitude with near precision accuracy. The coalition was wholly dependent on US SEAD assets to mount a "big effort" against the Iraqi IADS to create that medium altitude sanctuary. While this planning assumption proved flawed in execution, the coalition was able to shift resources to make up for the shortfall.

## **Chapter 4**

# **EXECUTION**

### **Introduction**

January 16<sup>th</sup> 1991 saw the air campaign start as planned, with enough air assets to begin phases 1-3 simultaneously. Changes to the plan's concept came quickly, as planners reacted to the politics of SCUDs, unexpected weapons systems effects, Iraqi reactions, and the inherent friction of executing versus preparing for war. All these inputs shaped the distribution of airpower resources, but never to the point where Deptula or Baptiste fought over apportionment.<sup>145</sup> With these changes coalition partners responded and contributed in different ways commensurate with their commitment. This chapter will examine how air force differences affected the campaign's tactical level execution and then tie these effects to the attainment of the air campaign's operational objectives.

### **Differences and Effects in Specific Areas**

#### **Munitions and Laser Designating**

As planned, after a few days most air commanders felt the threat had been reduced to the point where striker aircraft could shift to medium altitude operations. With this shift, two planning assumptions proved flawed. One was the climatology prediction. As noted in Chapter Two, the early air campaign saw ceilings lower than forecasted by 14 years of climate data, delaying the plan's timetable by several days. Although platforms like the F-117 could operate

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<sup>145</sup> LtCol Sam Baptiste, Chief, KTO Cell, interviewed by Dianne Putney and LtCol Richard Reynolds, College of Aerospace Doctrine, Research and Education, 24 September 1992, 42, K239.0472-72, in USAF Collection, AFHRA.

in a medium altitude sanctuary, they could not employ their LGBs. The other assumption quickly discounted was the ability of aircraft like the F-16 to employ unguided munitions from medium altitude with PGM like accuracy.

Given these conditions, strike packages could have compensated by attacking their targets at low altitude. Generals Horner and Glosson believed that any increased accuracy from low level attacks was not worth the risk of increased attrition.<sup>146</sup> With ample PGM-equipped assets, the coalition could afford to wait for the weather to improve. General Horner never directed minimum ceilings for target attacks and most air forces opted to stay at medium altitude.<sup>147</sup> The RAF was the notable exception, but even within their ranks there was dissension. Early on, RAF Jaguars opted for medium altitude diving attacks but for different reasons than the rest of the coalition. According to the RAF official historian, the Jaguar squadron commander decided he did not want to be the only coalition aircraft in the KTO at low level.<sup>148</sup> Such a decision negated the RAF's cluster munition since it was suited for low level attacks only. Fortunately for the Jaguars their rockets worked well from medium altitude. But because of inaccuracies in the jet's ballistics calculations, these rockets had to be withdrawn for two weeks awaiting a software fix.<sup>149</sup> The RAF was also able to purchase a large stock of CBU-87 from the US and began using these munitions on January 28<sup>th</sup>. Although the RAF's Operational Research Branch's CBU-87 effectiveness report is still classified, open sources show that pilots were very pleased with its results.<sup>150</sup>

RAF Tornados maintained their doctrine and JP-233 demanded they continue low level strikes. As the JP-233 airfield attack portion of phase one was drawing to a close, debate arose within the UK over the continued use of JP-233 against other suitable though less defended targets.<sup>151</sup> Advocacy for more JP-233 use came from the British arms industry, claiming that attacks to date had questioned the credibility of the Tornado and JP-233 as a viable weapon

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<sup>146</sup> GWAPS cites Generals Horner and Glosson's emphasis that no fixed target was worth an aircraft. In addition, General Horner said to the RAF on 19 January that he felt their low altitude losses unnecessary. *Gulf War Air Power Survey (GWAPS), Volume II, Part I, Operations*, (Washington, D.C.: US Government Printing Office, 1993), 154-5.

<sup>147</sup> For example, the RSAF and Kuwaiti Air Force immediately followed the American lead. Colonel Mike Kiraly, memorandum to GWAPS, subject: Saudi/Kuwait Trip – 8-16 July 92, 21 July 1992, 5, GWAPS NA-377, in USAF collection, AFHRA.

<sup>148</sup> Mr. Sebastian Cox, Head of Air Historical Branch (RAF), letter to author, 13 March 2001.

<sup>149</sup> Andy Evans, *SEPECAT Jaguar*, (Ramsbury, England: Crowood Press, 1998), 127.

<sup>150</sup> *Ibid*, 128.

<sup>151</sup> General Sir Peter de la Billière, *Storm Command: A Personal Account of the Gulf War* (London: HarperCollins, 1992), 231-2.

system. RAF leadership disagreed, maintaining that the weapon had done the job it was assigned to do and that further use carried unjustifiable risks.<sup>152</sup> RAF Tornados moved to medium altitude operations on January 29<sup>th</sup>.

Operations from medium altitude and PGMs are inextricably linked, since the former served to put a great premium on the latter. When the RAF Tornados went to medium altitude attacks, they first tried both visual and radar aimed unguided bombs with disappointing results.<sup>153</sup> With the USAF unable to provide buddy laser support, the RAF admirably hurried to get a laser designating capability into theater. By war's end the RAF Tornados were conducting mostly LGB attacks. The French did not seem to want to exploit their PGM capability. Most sources put their laser guided missile expenditures at 40% of available inventory, with these missions occurring in the first four weeks of the air campaign.<sup>154</sup> Late in the war they dropped a few 1000 pound LGBs, and it seems several factors contributed to this limited PGM employment. A former French Desert Storm planner suggests that a combination of limited laser designator pods and pilots trained to use them plus limited availability of PGMs was behind the restricted French employment.<sup>155</sup> Unfortunately, although the RSAF was known to possess PGMs, this author was unable to uncover specifics of their use.

## **Night Attack**

Night attacks entailed advantages and disadvantages. The primary advantages were in reducing exposure to the threat. During Desert Storm, night attacks negated optically launched and guided SAMs and AAA, as well as reduced exposure to Iraqi IR SAMs because these systems generally relied on optics for target acquisition. Taken together these factors forced the ground portion of the Iraqi IADS to rely on radar directed defenses. Night employment also meant the enemy had to rely on radar equipped fighters and adequately trained pilots for airborne defense. This was predominantly the case with the Iraqi Air Force, although there was some evidence their better pilots had trained in using ground controlled intercept and high-powered spotlights for night intercepts. Operationally, night attack provided a round the clock attack capability. Not only did this hinder the Iraqi's reconstitution efforts, but it also delivered a

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<sup>152</sup> *Ibid*, 233.

<sup>153</sup> *Ibid*, 231-2.

<sup>154</sup> Evans, *Jaguar*, 144.

<sup>155</sup> Major Didier Paquet, French Air Force, interviewed by LtCol Christopher Haave, USAF, French Joint Defense College, 9 April 2001.

psychological blow against the opponent.

The obvious disadvantage was that employment at night was more difficult, requiring sophisticated avionics to bomb accurately. Ground mapping radar equipped fighters with inertial navigation systems could bomb at night, but only against area targets from medium altitude. Forward looking IR systems allowed visually aimed bombing at night, but just as with F-16s during the day, results from medium altitude were disappointing during Desert Storm.

During the air campaign the numbers and variety of aircraft in theater made night attack differences among air forces a non-issue. Due to manning, most flying units could not run 24-hour operations and worked on a 12 hour schedule.<sup>156</sup> The same was true of carrier operations. Because of previously noted limited defensive capabilities, F-117s and F-111s were restricted to nighttime employment only. Other units, such F-16s lacking night vision systems, were used strictly in a daytime role because of the inaccuracies associated with their medium altitude radar bombing. With this baseline, planners could fit remaining assets to either daytime or nighttime roles to even out the mix. Several postwar commentaries pointed out the daytime only limitation imposed by the avionics of the French Jaguars. The reality is that other aircraft had similar limitations, especially with the emphasis on medium altitude bombing. And to maintain the 24-hour pressure on the Iraqis it was desirable to make some units day or night only, and keep them that way for continuity.

### **Interflight Communications**

Communications have traditionally been a challenge for coalition operations. After Desert Storm Secretary of Defense Aspin echoed the sentiments of many when he deplored the state of *joint* inter-flight communications. Yet relatively little has been noted concerning problems with US and allied aircraft voice communications. It seems that joint communication problems and an adversary unable or unwilling to exploit non-secure communications combined to overshadow allied tactical inter-flight radio shortcomings.

Aircraft requirements for inter-flight communication varied by the situation and depended in large part on the amount of coordination necessary during mission execution. Strike packages operating in close proximity to one another, or attacking targets in the same general vicinity within a short time span, needed direct communications to coordinate in-flight changes

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<sup>156</sup> *Gulf War Air Power Survey (GWAPS), Volume IV, Part I, Weapons, Tactics, and Training*, 271.

to the pre-briefed plan. Assets directly supporting a strike package, such as SEAD or air-to-air escort, usually required direct communications with all of the package members to coordinate defenses against air or ground threats. Given certain circumstances, at a minimum these support assets could maintain direct communications with the package commander, or AWACS, who then relayed instructions to the remainder of the strike package on another frequency.

Coalition strike packages would use the most secure radio system common to all aircraft, falling back on clear frequencies if necessary. Since most of the attacks deep into Iraq employed USAF, RAF, and RSAF aircraft, they were all able to communicate via Have Quick jam-resistant radios. In the KTO, procedures stipulated that kill box working frequencies be non-changing and in the clear.<sup>157</sup> If an aircraft needed to pass time-sensitive intelligence, then they were to use some secure means.<sup>158</sup> Not only were these procedures simpler for all coalition aircraft, but it accommodated allied aircraft without secure radios. Planners felt the importance of maintaining communications in the kill box environment outweighed the cost of the Iraqis exploiting communications on the kill box working frequencies. Since the Iraqis failed to exploit coalition clear communications, these decision proved not to be a liability.<sup>159</sup>

Most inter-flight communication challenges seem to have involved the USAF and USN. Besides the lack of Have Quick radios in most NAVCENT aircraft, CENTAF and NAVCENT planes operated their KY-58 secure radios in different modes, di-phase for the former and baseband for the latter.<sup>160</sup> During Desert Shield airborne controllers had trouble talking to USAF fighters on KY-58 radios and recommended CENTAF promulgate a message standardizing CENTAF secure radio switch settings.<sup>161</sup> It does not appear this message made it to NAVCENT and may have been a contributing factor to KY-58 radio problems. To make matters worse, for the first part of the war the Arabian fleet used callsigns and IFF transponder codes different than

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<sup>157</sup> See page 15 for a brief description of kill boxes. Major William R. Cronin, "C<sup>3</sup>I During the Air War in South Kuwait," *Marine Corps Gazette* 76, no. 3 (March 92): 36.

<sup>158</sup> For example, RAF Jaguars operating in the KTO used Have Quick extensively. Squadron Leader Chris Plain, RAF Jaguar pilot, telephone interview by author, 10 May 2001.

<sup>159</sup> Major Ken Ayers et. al., "Airborne Communications for Combat Plans," in *Air Force Tactical Communications in War: The Desert Shield/Desert Storm Comm Story*, ed. Colonel Randy Witt (Riyadh, Saudi Arabia: Hq CENTAF, March, 1991), 2-16.

<sup>160</sup> Gregory M. Snider, *The Navy's Experience with Joint Air Operations: Lessons Learned from Operations Desert Shield and Desert Storm* (Alexandria, Va.: Center for Naval Analyses, 1993), 40.

<sup>161</sup> Controllers for strike aircraft flew in EC-130 Airborne Command, Control, and Communications (ABCCC) aircraft. ABCCC aircraft contained a manned communications suite in the cargo area. 28th Air Division Desert Shield/Storm Lessons Learned, 10. (Secret) Information extracted is unclassified. In USAF Collection, AFHRA.



those assigned in the ATO.<sup>162</sup>

Three incidents serve to highlight the effects of these communication difficulties. According to one of the Black Hole USN planners, after the first few days the USAF decided to rely less on USN SEAD assets because of the inability of flight leads to talk to one another.<sup>163</sup> In the DCA arena, communications problems directly contributed to the penetration by Iraqi F-1s.<sup>164</sup> AWACS identified the attacking F-1s, but were unable, as were other NAVCENT units in the area, to contact the F-14s assigned to that sector's patrol. AWACS then vectored in a flight of RSAF F-15s who downed the Iraqi jets. Arabian fleet non-adherence to the ATO came to the attention of General Horner during the escape of two Iraqi Mig-23s to Iran.<sup>165</sup> Not only were the assigned F-14s 100 miles from their patrol station but they were also ignorant of ATO procedures concerning their mission. Admiral Arthur published a message emphasizing that the ATO was directive to *all* NAVCENT units. Such incidents caused a loss of USN credibility among USAF planners, reinforcing the reliance on USAF aircraft.

## SEAD

Execution of the air campaign's SEAD portion for the most part matched the original plan. Integration of the USAF and USN's capabilities, capitalizing on each service's strengths, was effective in destroying a number of Iraqi radars and forcing the others off the air. Most of the HARMs were launched in the first week of the war, and most of these were fired by the USN.<sup>166</sup> Iraqi SAM operators learned quickly to minimize radar on time to reduce exposure to coalition missiles and HARM shot doctrine got stricter to match these emissions control tactics. After several weeks, transmission of the HARM firing codeword 'Magnum' on a clear frequency was enough to shut down Iraqi radars.

Despite this early success, in certain areas the Iraqi IADS remained only suppressed, necessitating SEAD support accompany strike packages. RAND Corporation's post-war joint air operations analysis concluded the importance placed on electronic combat, because of the coalition's emphasis on minimizing casualties, and the corresponding need to respond to

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<sup>162</sup> USN Commanders Smith and McSwain, *Operation Desert Storm JFACC Special Planning Cell Review*, Desert Story Collection, 12, K239.0472-42, in USAF Collection, AFHRA.

<sup>163</sup> Ibid, 3.

<sup>164</sup> Swider, 40.

<sup>165</sup> Smith and McSwain, *Desert Storm*, 12.

<sup>166</sup> *Gulf War Air Power Survey (GWAPS), Volume II, Part II, Effects and Effectiveness*, 96.

potential surface-to-air threats made SEAD assets one of the war's two limiting factors.<sup>167</sup> The RAND analysts assert there was a constant tension over sharing of SEAD support between Iraq and the Kuwaiti theaters. Once air supremacy was attained in the KTO, planners tried to resolve the dilemma by assigning SEAD and air-to-air aircraft to area support vice direct package support roles, thereby spreading out the limited number of assets. All concerned were happy with the arrangement except for the Arabian fleet. Even after LtCol Baptiste's personal explanation of the shift to area rather than direct support, the Arabian fleet planners kept asking for direct SEAD support embedded in their strike packages instead of relying on the area support already built into the plan. Not only did such embedded support consume precious SEAD resources, but the USN aircraft the Arabian fleet wanted to perform SEAD could have conducted strike missions instead.<sup>168</sup> In the planner's defense, from an EA-6 aircrew account it appears that the Arabian fleet commander made EA-6 coverage a go/no go item for his strike packages while the Red Sea fleet commander may have had a different policy.<sup>169</sup>

One of the coalition's overriding objectives was to minimize friendly casualties. Overall, the coalition considered itself extremely successful in this area, with aircraft attrition well below any pre-war estimate. Losses to radar SAMs greatly decreased as the war progressed and can be attributed to effective SEAD work and the switch to medium altitude operations. During the campaign's last two weeks the only radar SAM loss occurred while the ground phase was underway and can be partly attributed to the decision to fly under low ceilings to provide ground support.<sup>170</sup> While individual aircraft self-protection systems no doubt played a role in the low attrition numbers, any attempts to directly measure their effectiveness are not only difficult but also classified. Indirectly, the 35<sup>th</sup> Tactical Fighter Wing provided the anecdotal evidence that out of five aircraft losses to radar SAMs, four did not have F-4G support. Although a bit self serving, it suggests the importance of dedicated SEAD assets in addition to self protection

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<sup>167</sup> James A. Winnefeld and Dana J. Johnson, *Joint Air Operations: Pursuit of Unity in C<sup>2</sup> 1942-91*, (Annapolis: Naval Institute Press, 1993), 123.

<sup>168</sup> Baptiste interview, 59.

<sup>169</sup> GWAPS notes that NAVCENT policy made EA-6s an USN strike package go/no go criteria and cite Commander Luti's "Battle of the Airwaves" article. Luti mentions EA-6s as a go/no go item but does not ascribe it to NAVCENT. Furthermore, he flew with the Arabian fleet during the war and was probably more familiar with their procedures. See Commander William J. Luti, "Battle of the Airwaves," *US Naval Institute Proceedings*, January 1992, 53.

<sup>170</sup> *GWAPS, Volume II, Part II, Effects and Effectiveness*, 142.

equipment.<sup>171</sup>

RAF Tornado losses totaled six by the war's end, four of which occurred while in low altitude attacks.<sup>172</sup> Most of the losses were speculated to be from the tremendous amount of AAA encountered over their targets. Immediate post war analysis, especially commentary in the UK, vilified the RAF as slaves to European low level tactics. Combined with the mixed results of the JP-233 raids, the losses seemed to strengthen the case against the viability of low level attacks.

The RAF estimated that none of the losses during low level JP-233 attacks were due to AAA. One Tornado was lost 45 seconds into its egress from a JP-233 attack and it is presumed the crew flew into the ground. Two of the losses took place at medium altitude, and one of those was from the premature detonation of the jet's 1000 pound bomb. Adding that all of the Tornado reconnaissance missions were flown at night and low level without loss it is difficult to conclude that the AAA threat in the low level environment played a significant role in the RAF's relatively high loss rate compared to the rest of the coalition.<sup>173</sup>

### **Tactical Reconnaissance**

GWAPS identified tactical reconnaissance as a shortfall during Desert Storm.<sup>174</sup> Part of the reason lies in the move by the USAF to rely on overhead satellite imagery instead of aircraft overflight to provide battle damage assessment (BDA). When the intelligence infrastructure did not allow for rapid BDA from national assets, air campaign planners turned to alternate channels including in-theater aircraft to provide that information. USAF RF-4s were quickly overwhelmed by tasking from both planners and local units requesting post strike reconnaissance. Other air forces had an inherent tactical reconnaissance capability, but these aircraft followed traditional patterns of supporting their own country or service's post strike reconnaissance needs. Although it is doubtful that the limited number of assets were capable of meeting all requirements, two actions could have facilitated their employment. First, there was no attempt to centrally coordinate tactical reconnaissance flights, which could have improved the

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<sup>171</sup> Thomas A. Keaney and Eliot A. Cohen, *Revolution in Warfare? Air Power in the Persian Gulf* (Annapolis: Naval Institute Press. 1995), 196.

<sup>172</sup> RAF Tornado loss data compiled from Alfred Price, "Tornado in the Desert," *Air Force Magazine* 75, no 12 (December 1992): 45-6 and de la Billière, 208.

<sup>173</sup> Air Chief Marshal Sir Patrick Hine, "Despatch: Operation Granby," *Second Supplement to the London Gazette*, 28 June 1991, G42.

reconnaissance effort.<sup>175</sup> Secondly, a system to collect and distribute this intelligence amongst all the allied units was lacking.

## IFF

As already noted, avoiding fratricide was a major determinant in air-to-air ROE. The majority of coalition aircraft carried IFF transponders which provided a means for USAF F-15s and AWACS to discriminate between coalition and Iraqi aircraft. Friendly aircraft not so equipped relied on visual identification to prevent inadvertent engagements. French, Kuwaiti, and Qatari Air Force F-1s presented a unique problem as the Iraqis flew the same aircraft.<sup>176</sup> This identification problem was compounded by the intelligence assessment that the best Iraqi pilots were assigned to F-1 units.

Initially, coalition F-1s were kept on the ground so that friendly fighters knew any F-1s in the air were Iraqi. As the Iraqi air threat diminished, allied F-1s were allowed to fly missions. Because a slight Iraqi air threat existed throughout the war, F-1s were constrained in their employment. Kuwaiti F-1s only flew with that country's A-4s and the word went out not to shoot at F-1s in formation with A-4s.<sup>177</sup> The Qataris did something similar, only flying their F-1s with USAF F-16s sharing their base at Doha.<sup>178</sup> The French did the same, pairing F1-CRs with their Jaguars not only to prevent fratricide but also to take advantage of the better navigation system on their F-1s.<sup>179</sup> Overall, since the Iraqis chose not to challenge the coalition in the air and the F-1s represented a fraction of the coalition's fighter aircraft, the benefits of these precautions far outweighed their costs. The emphasis on stringent ROE, enough F-15Cs with IFF interrogators to implement the ROE in forward CAPs, and these tactical expedients contributed to zero airborne fratricide throughout the war.

Also of note is that of the 38 confirmed air-to-air kills in Desert Storm, 16 were F-15C radar missile beyond visual range shots. In most of these engagements, the beyond visual range ROE criteria of "hostile aircraft, no friendlies within field of fire," was satisfied by AWACS

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<sup>174</sup> Keaney and Cohen, 163.

<sup>175</sup> Smith and McSwain, *Desert Storm*, 13.

<sup>176</sup> French F1-CRs had Mode IV IFF transponders but documentation available to the author did not elaborate on the other country's F-1s. More than likely they did not have Mode IV transponders.

<sup>177</sup> Thomas Keaney, Trip Report on Visit to Saudi Arabia and Kuwaiti, 9-16 July 1992, 11, GWAPS NA-377, in USAF Collection, AFHRA.

<sup>178</sup> 614<sup>th</sup> Tactical Fighter Squadron, Desert Shield/Desert Storm AAR, 27, K-SQ-FI-612-HI, in USAF Collection, AFHRA.

using their IFF interrogators.<sup>180</sup>

## Air Refueling

The RAND Desert Storm study cited air-to-air refueling as the other limiting factor during the air campaign.<sup>181</sup> GWAPS saw the issue a little differently, claiming that coordinating airspace for air refueling and not the tanker's numbers themselves was the greater part of the challenge.<sup>182</sup>

Air refueling had a significant effect on USN flight operations. The Red Sea fleet relied on land based tanking, as did the Arabian fleet for part of the war. USN planners were highly critical of USAF tanker support. They believed that more of the KC-10 fleet, with a permanent drogue system, should have been allocated to USN strike packages and CAP missions and accused USAF planners of favoring their parent service while shortchanging other coalition members. USAF planners countered that their goal was to maximize the use of the combined tanker assets by servicing the highest number of targets possible regardless of the delivery platform's parent service.

As the campaign progressed, the USN took a number of steps to alleviate part of the shortfall. The first involved restricting the Red Sea fleet to KTO strikes only.<sup>183</sup> Carriers launched refueling aircraft as "hose multipliers," these aircraft would take fuel from KC-135s and then pass it on to USN fighters.<sup>184</sup> With the movement of the Arabian fleet forward its air refueling needs were drastically reduced to where only its airborne patrol required land based tanking.<sup>185</sup>

Allied tanking needs differed based on mission. DCA aircraft required the most fuel

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<sup>179</sup> Evans, *Jaguar*, 147.

<sup>180</sup> GWAPS, *Volume II, Part II, Effects and Effectiveness*, 113.

<sup>181</sup> Winnefeld and Johnson, 123.

<sup>182</sup> Keaney and Cohen, 159.

<sup>183</sup> This may seem counterintuitive since the Red Sea was closer to certain target sets in Iraq than to the KTO. Several factors are at work here. The Red Sea was closer to western Iraqi targets, compared to the KTO, but the KTO was closer than targets in eastern Iraq. Strike packages flying to the KTO did not have to fly that much further for air refueling tracks, where as these air refueling tracks were out of the way for Red Sea strikes going to western Iraq. It seems the main issue revolved around the USN wanting to send more support assets with its strike packages into Iraq, requiring more gas, as compared to USN strike packages sent to the KTO. Smith and McSwain, *Desert Storm*, 4.

<sup>184</sup> Major Rich King, Trip Report, US Navy Desert Storm Operational Debrief, 28 May 1991, 6. (Secret) Information extracted is unclassified. GWAPS TF VI-47, Folder 498, in USAF collection, AFHRA.

<sup>185</sup> Frank Schwamb et al, *Desert Storm Reconstruction Report (U), Volume II: Strike Warfare (U)* CRM 91-178 (Alexandria, Va.: Center For Naval Analyses, 1991), 7-36, (Secret) Information extracted is unclassified.

because of their long sortie duration, followed by strike aircraft proceeding deep into Iraq. As noted, most of the major participants had tanker aircraft, including the Canadians, but their one tanker was grounded on January 30<sup>th</sup> due to a hydraulic problem.<sup>186</sup> The small fleet of French C-135FRs were able to support the Mirage 2000s since French Jaguars and F1-CRs flew missions mostly in the KTO and required refueling on only a quarter of their sorties.<sup>187</sup> The rest of the tankers formed a common pool, tasked according to their equipment rather than their nationality. Here the RAF tankers played an important role because of their numbers and dedicated drogue configuration, which probe flying pilots found preferable to the USAF KC-135 system. The symbiotic relationship formed early between the USN and RAF continued throughout the war. In return for RAF gas the Red Sea fleet provided requested SEAD support to RAF Tornado attacks.<sup>188</sup> Additionally, CF-18s and USN CAP and strike aircraft took advantage of the RAF tankers.<sup>189</sup> With the number of allied drogue tankers in theater, planners reduced the reconfigurations of USAF KC-135s, saving time and equipment wear and tear.

Overall, meeting the air refueling requirements of an operation the size of Desert Storm was a difficult planning task. The US General Accounting Office (GAO) assessed that while the coalition tanker fleet adequately supported the coalition, it did so inefficiently, with 40% of fuel carried by US tankers going unused.<sup>190</sup> Part of this inefficiency was due to weather cancellation of missions and the difficulty of estimating aircraft fuel needs given the unknown of the early combat missions. As the Iraqi threat subsided and sorties became more routine the efficiency of the system improved, but the GAO report makes a good case for trying to improve the system as a whole in the future.

## **Chain of Commands**

Although not a capability difference per se, the issue is important to understanding the complexity of analyzing different country contributions to a coalition. For Desert Storm, allied air forces enjoyed a dual line of command, one to the operational commander, CFACC General

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<sup>186</sup> Major Jean H. Morin and Lt-Comdr Richard H. Gimblett, *Operation Friction: The Canadian Forces in the Persian Gulf* (Toronto: Durndurn Press, 1997), 171.

<sup>187</sup> Evans, *Jagaur*, 149.

<sup>188</sup> Schwamb, 7-2.

<sup>189</sup> ACM Hine, G42.

<sup>190</sup> Comptroller General of the United States, *Operation Desert Storm: An Assessment of Aerial Refueling Operational Efficiency* (Washington, D.C.: General Accounting Office, 1993), 1.

Horner, and the other to their national command authority.<sup>191</sup> Respective national commands could veto participation of their units in certain operations but could not prevent the operation itself. For example, the RAF declined to attack two targets because of collateral damage concerns.<sup>192</sup> Likewise, the French refused to bomb freeway bridges because their leaders did not view them as legitimate military targets.<sup>193</sup> In these circumstances air planners merely had to use other coalition assets to attack those targets.

The other important point is the sister service and multinational representation on the CFACC staff, especially the Black Hole. Since there was no pre-existing coalition command structure, CENTAF formed the nucleus of the CENTAF staff, with other air forces adding on representation. On the plus side the presence of USAF officers in command billets created unity of effort but also created some friction. In numerous after action reports the USN criticized itself for underrepresentation on the CFACC staff, in both numbers and equivalent ranks.<sup>194</sup> With the number of sorties allocated to carrier air, the USN correctly concluded the campaign would have benefited by a more commensurate USN CFACC component and the collocation of the NAVCENT Commander and his staff in Riyadh instead of afloat in the Arabian Gulf. Members of the RAF also noted the difficult job their one Black Hole planner had in integrating all RAF operations into the overall air campaign.

### **Differences by Phase**

General Glosson thought of the Iraqi theater as the place to win the war with airpower and focused his attention and most capable aircraft there, viewing the KTO as a sideshow.<sup>195</sup> With Iraqi intransigence and apparent coalition impatience to wait Saddam out, General Horner had his planners shift combat power to phase three operations in preparation of the ground war.

### **Phases One and Two**

As expected, the coalition fighters proved too much for the Iraqis. Coalition pilots manning the forward CAPs quickly racked up a number of air-to-air kills. In addition to CAP

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<sup>191</sup> During Desert Shield French Air Forces reported to Saudi General Khaled Bin Sultan but were transferred to General Horner at the start of Desert Storm.

<sup>192</sup> David White, "RAF 'turned down' Two Gulf Targets," *London Financial Times*, 23 May 1991.

<sup>193</sup> Paquet interview.

<sup>194</sup> Smith and McSwain, *Desert Storm*, 11, and King Trip Report, 2.

<sup>195</sup> Baptiste interview, 43.

duty, fighters provided sweep and escort for strike packages, which all allied fighters flew except for RAF /RSAF air defense variant Tornados. Both the British and Saudis were hesitant to pit these jets against some of the Iraqi fighters and the large numbers of fourth generation coalition fighters allowed the Tornados to perform in a rear guard role. In the sweep mission, fighters would precede a strike package, clearing its route and target area of enemy aircraft and then do the same on egress. In the escort role they were more tightly tied to a specific package to respond to any airborne threats which might arise. Notably, RSAF F-15Cs, in concert with USAF F-15Cs, flew sweep missions deep into Iraq on several occasions.

Day three and attack package Q would have a profound effect on the remainder of the air campaign.<sup>196</sup> Package Q was the first large scale daylight raid by a predominantly F-16 force on targets in the vicinity of Baghdad. Besides physical destruction, planners were hoping for a major psychological blow—showing the Iraqis their vulnerability to airpower’s effects through the massing of fighters in daylight over their capital. The strike did not go as planned. Coordination problems caused the SEAD support aircraft to have return to base early. Baghdad’s defenses were still formidable, shooting down several coalition aircraft while causing others to jettison their ordnance during evasive maneuvers. General Horner and his planners decided against sending any more F-16s over Baghdad. They could not afford the propaganda exploitation of jettisoned ordnance over populated areas, especially when F-117s could attack such targets with relative impunity. For the remainder of the war only the F-117, because of its stealth and PGM characteristics, would visit downtown Baghdad. Since they would only fly at night, USN Tomahawks carried the load during the day to maintain round the clock coverage.

In the OCA effort the RAF and RSAF Tornados carried out repeated airfield attacks with both JP-233 and unguided munitions. Although the RAF JP-233 analysis report is still classified, the British commander in theater summarized its effectiveness in his post war memoirs.<sup>197</sup> The JP-233 was designed for the central European theater against Warsaw Pact airfields, which were constructed differently than Iraqi strips. The relatively low density of the sand underneath the targeted taxiways minimized the cratering effect of the JP-233 submunition. Damage caused by the bomblets was quickly repaired and the airfields were operational within several hours. The JP-233 received some bad press, especially in the United Kingdom where it was not understood

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<sup>196</sup> Package Q specifics extracted from *GWAPS, Volume II, Part I, Planning*, 177.

<sup>197</sup> de la Billière, 212.



that the attacks were only meant to disrupt airfield operations and not completely shut them down. Combined with the aggressive forward F-15 patrols, the Iraqis never challenged the coalition in the air. Instead, as several intelligence agencies had predicted, the Iraqi Air Force chose to husband its aircraft in their hardened aircraft shelters.

Coalition planners countered this tactic by implementing a shelter busting operation. Since enemy shelter construction varied, planners targeted them with different munitions. Some third generation shelters, capable of withstanding near misses by large conventional bombs, required penetrating PGMs. Initially F-111Fs were used in these attacks, and were later joined by F-117s. Other shelters were not as strong and presented an opportunity for the RAF to expand its airfield attack role. The RAF had postured itself for precision attacks by stockpiling LGBs at its two Tornado locations during Desert Shield. With Buccaneers in theater, the RAF Tornados quickly took part in shelter busting missions. Designating pod equipped jets did the same, with ammunition and fuel storage areas, airfield facilities, and aircraft shelters comprising their target mix.<sup>198</sup>

Besides hiding jets in their shelters, the Iraqi aircraft began an exodus to Iran. With this unexpected move the USN tried to re-engage on the air-to-air ROE issue. USN planners claimed the longer range and receding target capability of its radar missile made the F-14 better suited to the forward CAP station than the F-15C. The USN eventually manned one of the forward CAPs, but it was late in the war, after Iraqi air activity had dwindled to a trickle. USN planners felt their service was discriminated against, that beyond visual range electronic identification capabilities and ROE were used as a ruse to prevent their fighters from getting Iraqi kills.<sup>199</sup> This story of USAF and USN CAPs goes beyond simple capability differences and is intimately tied to the fact that USN air operated as two distinct entities.

LtCol Deptula claimed that, early in the war, the Red Sea fleet was offered one of the forward CAPs.<sup>200</sup> But due to deck cycle operations the Red Sea fleet required three carriers to provide 24 hour CAP. For operational reasons NAVCENT moved one of the Red Sea fleet carriers to the Arabian Gulf, making the Red Sea fleet unable to provide 24 hour CAP coverage. In the Arabian Gulf, previously noted communication and procedural problems with the Arabian fleet made their manning of forward patrols problematic.

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<sup>198</sup> Peter Binham, "TIALD – A Casebook of Cooperation," *The Hawk*, 1992, 21.

<sup>199</sup> Smith and McSwain, *Desert Storm*, 5-6.

Coalition planners were not surprised by Iraqi SCUD attacks. What was underestimated by CENTAF, especially General Horner, was the political fallout of the attacks and the subsequent drain on air resources to counter the mobile SCUD threat. Allied aircraft, including French Jaguars and RAF/RSAF Tornados, joined US strikers in targeting fixed SCUD launch sites and resupply points. The search for mobile SCUDs proved to be mostly an USAF affair. 20% all available A-10s sorties quickly drove the mobile SCUDs to nighttime employment, where finding them required IR detection equipment.<sup>201</sup> A full 25% of the available F-15Es, because of their targeting pods, took part in the “great SCUD hunt.” The other coalition platform heavily tasked was IR pod equipped F-16s.<sup>202</sup> Allied tactical reconnaissance searched for SCUDs as well, most notably RAF Tornado GR.1As.

In phase one the coalition had hoped to destroy Iraq’s political and military command system plus its NBC capability; disrupt electrical power, oil storage, and military resupply; attrit the Republican Guard; and attack the Iraqi IADS. Because of the hardened nature of many of these target sets, especially in the command and control and NBC categories, USAF fighters carrying penetrating PGMs were used almost exclusively. RAF and RSAF Tornados made significant contributions against Iraqi airfields, including both infrastructure and aircraft shelters with the introduction of an LGB capability by the RAF. French Jaguars briefly contributed to these phases on the first three days, but by day four were assigned to attriting Iraqi fielded forces in the KTO. Although not directly part of countering the mobile SCUD threat, USN and allied precision platforms helped fill the void when predominantly USAF resources with IR detection equipment were diverted to this effort.

Complementing strengths of USAF and USN SEAD aircraft combined with sheer numbers of coalition aircraft contributed to phase two’s objective of air supremacy throughout the KTO allowing “unhindered” coalition strike operations. The coalition depended on the electronic combat capabilities of the US, and the aggressive initial SEAD effort combined with a compliant enemy enabled less capable allied aircraft “freedom of maneuver” throughout the KTO. Low attrition of coalition aircraft and absence of air-to-air fratricide played an important role in maintaining coalition cohesiveness and popular support.

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<sup>200</sup> LtCol Deptula’s written comments in the margins to Smith and McSwain’s, *Desert Storm*, 5 .

<sup>201</sup> Fred Frostic, *Air Campaign Against the Iraqi Army in the Kuwait Theater of Operations*, RAND Report MR-357-AF (Santa Monica, Calif.: RAND, 1994), 16.

<sup>202</sup> LANTIRN navigation pod carrying F-16s. *GWAPS, Volume IV, Part I, Weapons, Tactics, and Training*, 275.

## Phases Three and Four

Coalition air forces sought to cut the flow of supplies and material to Iraqi forces through targeting of convoys, logistics sites, and bridges. Initially F-16 and F/A-18s employing unguided bombs struck bridges from medium altitude, but after poor results planners opted for PGMs. While all coalition aircraft attacked ammunition and fuel storage areas, the RAF played a significant role in bridge cutting operations. For the first two weeks in February RAF Tornados were the primary coalition bridge bombers.<sup>203</sup> By war's end these aircraft had conducted over one-eighth of the coalition PGM bridge attacks.<sup>204</sup> On February 10<sup>th</sup> the French Jaguars used their laser guided missiles to great effect against Iraqi bridges but for undisclosed reasons never after that.<sup>205</sup> Perhaps planners believed LGBs more suitable to downing bridge spans and the limited French missiles better used against Iraqi mechanized forces.

Initially the weight of the air campaign was thrown into phases one and two, with coalition strikes against the Iraqi military assigned discrete targets. As the air campaign's main effort shifted to phase three, the kill box system was instituted on January 20<sup>th</sup> to provide coordination and deconfliction of the growing number of sorties directed at the KTO. Missions would take off and check in with airborne controllers for updates prior to working the 30 nautical mile square pieces of real estate. If the mission's originally assigned kill box proved unproductive for previous flights, then controllers could reroute it to hopefully more profitable areas. This type of system was very flexible for shifting airpower around the KTO and was reliant on airborne controllers for command and control. The simple communications procedures described earlier accounted for a large part of the system's success.

GWAPS found a division of labor in the Kuwaiti theater assignments. "More capable" F-16s, F-111Fs, and F/A-18s focused on Republican Guard Units, while AV-8s, A-10s, and allied aircraft tried to attrit entrenched infantry units along the border.<sup>206</sup> Range and lack of air refueling, combined with weapons effects of unguided munitions against infantry, validated the allied aircraft assignment. But A-10s and AV-8s cannot be described as less capable ground attack aircraft, especially against mechanized forces. These units were also getting familiar with both the terrain and units they would be supporting in anticipation of the ground war. When the

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<sup>203</sup> Frostic, 20.

<sup>204</sup> *GWAPS, Volume II, Part II, Effects and Effectiveness*, 177.

<sup>205</sup> Evans, *Jaguar*, 149.

<sup>206</sup> Keaney and Cohen, 13.

ground war did come the amount of US airpower in theater plus feeble Iraqi resistance made USN or non-US coalition close air support unnecessary.

In attacking Iraqi mechanized units F-111Fs pioneered the heralded “tank-plinking” tactic, a bit of a misnomer since it actually involved dropping 500 pound LGBs against prepared artillery sites in addition to tanks and armored personnel carriers. Soon F-15Es and A-6s employed the same tactics with equal success. Allied fighters used general purpose and cluster bombs plus rockets against a variety of targets. For example, RAF Jaguar rocket and cluster bomb attacks targeted SAMs, artillery, command centers, and surface-to-surface anti-ship missile sites.<sup>207</sup> French Jaguars reportedly experienced an 80% hit rate with their laser guided missiles against similar targets, in addition to several Iraqi patrol boats. French Jaguars overcame their limited navigation kit by pairing with better equipped F1-CRs for packaged strikes against Republican Guard divisional command posts. With the initiation of the ground war previously air-to-air only CF-18s began attacking Iraqi ground units with unguided general purpose bombs. The Canadians tried to get into the precision game with USN offered 1000 pound LGBs and buddy laser support, but the war ended before the bombs arrived.<sup>208</sup>

Through interdiction and attrition air planners initially sought a 50% reduction in Iraqi ground equipment to meet their perception of Schwarzkopf’s criteria to begin Desert Storm’s ground phase. Due to a number of unforeseen complications in intelligence gathering and BDA, accurately tracking the destruction of Iraqi armor and artillery proved difficult, and Schwarzkopf used a subjective assessment of “combat capability” in deciding to launch the ground war. Post war analyses such as GWAPS showed that the destruction of equipment was less than originally estimated during Desert Storm. This was despite the advantage of numerous imaging sources including aircraft video tape recorders on aircraft like F-111Fs and F-117s. Most allied aircraft did not enjoy the benefit of similar equipment.

Given these shortcomings and the classification of allied effectiveness reports, only general impressions of allied contributions to phase three’s objectives are possible here. By January 25<sup>th</sup> the coalition was averaging 1000 strike fighter sorties into the KTO per day, 10% of which were allied.<sup>209</sup> Given the relative effectiveness of unguided versus guided munitions it can be assumed that allied contributions helped with the gradual reduction of Iraqi’s fielded

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<sup>207</sup> Anti-ship missile sites were SY-1 Silkworms.

<sup>208</sup> Morin and Gimblett, 174.

forces.<sup>210</sup> In addition to physical destruction the allied air strikes probably had a relatively larger role in the psychological effect on ground forces due to the ubiquity of the air campaign. Iraqi prisoners of war reported they felt that they were under constant threat of air attack, that one could materialize at any minute and they were powerless to stop it.<sup>211</sup> The allies also played a significant role in attriting the Iraqi Navy and more importantly their coastal anti-ship missiles. As a result, the Arabian fleet could steam closer to targets and the possibility of an amphibious assault remained a factor in Iraqi decision-making. Like in the mobile SCUD hunt, numbers and various capabilities gave planners a great deal of flexibility. They could afford the diversion of A-10s to daytime SCUD patrols with other coalition fighters picking up the slack. RAF Tornado LGB missions freed up US LGB platforms, like F-111Fs, F-15Es, and A-6s, for tank plinking.<sup>212</sup>

## Summary

At the tactical level capability differences had a moderate effect on the air campaign. Good weather, a medium altitude sanctuary, and poor performance of unguided bombs from said sanctuary all contributed to put a premium on PGM capability. Most targets in Iraq and all enemy mechanized units called for USAF, RAF, and some USN PGM aircraft while non-PGM aircraft were relegated to non-mechanized ground forces in the KTO. The only exceptions were Iraqi airfields attacked by RAF/RSF Tornados.

In most other areas capability differences were overshadowed by many of the same factors summarized in Chapter Three. Sheer numbers and diversity of night attack capabilities within the coalition negated this differences effect. Variations in aircraft jam resistant and secure radios had little effect since the decision to use clear frequencies was never exploited by the Iraqis. Differences in IFF equipment proved more of an interservice squabble because of stringent air-to-air ROE, adherence to the ROE, abundance of USAF F-15Cs able to shoot beyond visual range under said ROE, and Iraqis wisely choosing not to challenge the coalition in the air. Air refueling differences led to effective if somewhat inefficient support, causing the USN to look to the RAF for additional support. One exception was tactical reconnaissance, where the coalition as whole was deficient. The inability of these assets to meet demand

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<sup>209</sup> Frostic, 17 and 61.

<sup>210</sup> *GWAPS, Volume II, Part II, Effects and Effectiveness*, 98.

<sup>211</sup> Frostic, 61.

<sup>212</sup> *Ibid.*

involved more the issue of collection and distribution rather than air force differences in tactical reconnaissance capabilities.

At the operational level execution was close to the concept laid out by planners during Desert Shield, requiring adjustments for weather and SCUDs. The split nature of the air war allowed planners to allocate resources accordingly, thus maximizing the contributions of each ally. This effort was facilitated by the phasing of air operations, shifting emphasis from targets in Iraq to fielded forces in Kuwait as the war progressed. The value of OCA, including SEAD, cannot be overemphasized. Even with the Iraqi defenses centered on Baghdad and the Republican Guard, the early neutralization of the Iraqi air and ground threat enabled less capable allied aircraft, in terms of self-protection, to operate effectively throughout the theater. During phases three and four, non-PGM allied aircraft made mostly a psychological contribution to achieving coalition objectives of degrading Iraqi ground combat effectiveness, while PGM aircraft contributed both physical and psychological effects.

Besides the spectrum of capability differences across the coalition, tolerance to risk varied as well. On one end was the US, represented by General Horner's comment that no fixed target was worth an aircraft. General Horner also told his staff that things changed when friendly troops were in contact with the enemy, that he wanted aircrews to feel a 'push' to provide support.<sup>213</sup> At the other end were the Kuwaitis and British. Naturally the Kuwaitis had more at stake in the conflict, and they expressed pride in losing an aircraft on the first day.<sup>214</sup> The RAF firmly believed in fight as you train and were reluctant to abandon low level tactics. On one hand their force structure and training centered on low altitude employment. Additionally, one commentator suggests that previous combat experiences producing a 'rally around the flag' effect may have reduced the British aversion to casualties.<sup>215</sup> Other coalition attitudes fell somewhere in between these two positions, shaped by the political and cultural particulars of their situation.

The USAF dominated chain of command, US aversion to casualties, Iraqi threat, desert environment, and PGM capabilities all factored in the decision to switch to medium altitude employment. This decision affected the ability of other coalition air forces to effectively employ

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<sup>213</sup> *GWAPS, Volume II, Part I, Operations*, 296.

<sup>214</sup> Kiraly, Saudi/Kuwait trip memo, 5.

<sup>215</sup> Lawrence Freedman, *Gulf War Lessons Learned by Foreign Countries: Britain* (Los Alamos, N.Mex.: Center for National Security Studies, Los Alamos National Laboratories, 1991), 16.

given their equipment and training. With hindsight this appears to have been the right decision, but also serves to highlight that the different mindsets of coalition members can be an important planning consideration in addition to capability differences.

## **Chapter 5**

### **CONCLUSIONS**

*In all cases, effective command and control is the primary means of successfully extending the joint vision to multinational operations. . . The overall effectiveness of multinational operations is . . . dependent on interoperability between organizations, processes, and technologies.*

*Joint Vision 2020*

#### **Introduction**

Overall, the capability differences among the coalition air forces had a moderate effect tactically and a minor effect operationally in the Desert Storm air campaign. Given the capability differences outlined earlier, this chapter will summarize the coalition responses in dealing with the most challenging differences. This work suggests the importance and difficulty of separating contextual elements from technical capabilities in analyzing modern coalition air warfare, and therefore recommends areas to be included in a future comparative analysis of capability differences encountered in Allied Force. Finally, what Desert Storm may portend for future coalition air warfare is briefly explored.

#### **Dealing with the Gap in Desert Storm**

When the shift to medium altitude operations plus collateral damage concerns placed even a greater premium on PGMs, the argument could be made that the coalition needed more PGMs and PGM capable platforms. More PGM capability may have resulted in the faster destruction of more Iraqi target sets vice the psychological degradation inflicted by unguided munitions on fielded forces. Implicit in this argument is a cost benefit analysis in which the increased cost of such weapons is worth their



greater effectiveness. The counter argument is if the psychological effect of continuous bombing of both unguided and guided munitions achieved the necessary reduction in enemy combat capability, then the additional cost to the allies may not be warranted.

Three methods of responding to the need for greater precision were evident in Desert Storm. US forces shifted their PGM aircraft around the battlefield, especially as the focus of the air campaign shifted from strategic attack to battlefield preparation. The RAF took great pains to introduce and expand its PGM capability in theater, especially when its runway denial missions were coming to a close. The French, for apparent political reasons, kept a good deal of their precision and night attack capability in the form of their Mirage 2000N at home, content to expend a limited number of laser guided missiles and LGBs in its attacks.

Obviously political will and agenda were important, as both the British and French had PGM capabilities but the former used theirs to greater effect. Just as important is that both air forces had a PGM capability prior to the conflict, they just chose different ways to exploit it. None of the air forces acquired a PGM capability during the Gulf War, including the RAF. Buccaneers and their associated laser designators had been in the RAF's inventory for some time, and the introduction of the Tornado's laser designator pod, under development before the war began, represented merely an improvement in the RAF's PGM capability. Because of the complexity of employing munitions like PGMs it would be difficult for any air force to effectively field such a capability from scratch during a short campaign such as Desert Storm.

Interflight communications is a difficult area to assess because its success is tied to coordinating procedures. As communication equipment increases in sophistication the requirements for proper coordination are greatly magnified. These range from simply assuring everyone has the right frequency assignments to coordinating frequency hopping schemes and time synchronization for Have Quick users and proper radio switches and keying for secure systems like KY-58. The split nature of the war combined with Iraqi inaction allowed flights to operate on clear frequencies without interference. Not to say that this situation, and a similar communications scheme, could not work in the future, however, the prudent strategist would rather not rely on open communications in a hostile environment. The experience underscores the importance of a simple and common

communication architecture for coalition warfare, especially as the number of entities increases.

Both the coalition and the Iraqis conspired to minimize effects due to differences in aircraft radar warning receivers and self-protection electronic countermeasure systems. The emphasis placed on air superiority, aiming for air supremacy in the KTO, and Iraqi inability to counter the corresponding OCA effort created a medium altitude sanctuary for coalition aircraft. To create this sanctuary the coalition relied on the complementary nature of USAF and USN SEAD assets. Confining the least capable strike aircraft, in terms of self-protection, to the less defended Kuwaiti border also minimized electronic combat discrepancies.

The extraordinary number of coalition sorties and air-to-air kill record combined with zero airborne fratricide was a remarkable achievement. Once again the Iraqi's reluctance to challenge DCA CAPs helped friendly fighters give pause before employing ordnance on suspected enemy aircraft. The importance of preventing fratricide led to the implementation of very restrictive air-to-air ROE, which, in hindsight, was a good decision. Hand in hand with the ROE was the short notice addition of IFF transponders to coalition aircraft predicated to strike deep into Iraq, such as the RAF jets. Air-to-air ROE relied on large numbers of USAF F-15Cs manning forward patrols and AWACS to interrogate returning strikers' IFF transponders. The restriction of IFF transponder equipped aircraft to southern Kuwait eased the identification problem. For coalition F-1s, their minor role in the coalition's plan allowed their grounding until the Iraqi air threat was neutralized, after which they were paired with other coalition aircraft.

Coalition planners minimized the challenges of air refueling through pooling of resources and scrutinizing tanker requests, maximizing effects achieved for gas expended. This involved the orchestrating of boom and drogue tankers to service the coalition's different receiver configurations. Still, large numbers of tankers filled the skies every day, and creative airspace management, aircrew vigilance, and a little luck ensured receivers got their gas without a midair collision. The various air forces provided what they could, but overall the coalition relied on land based USAF tankers to conduct the war.

## **Future Research on Allied Force**

As outlined in Chapter One, this author believes a comparison of Allied Force with Desert Storm in terms of coalition capability differences would give an additional perspective on the subject. The following are starting points for a comparative analysis: changes in size of air forces since the Gulf War, especially US electronic jammers and USAF tankers; environmental differences between the two conflicts, especially in weather, terrain, and theater size; higher expectation of minimum collateral damage and friendly casualties created by Desert Storm; differences in interservice and multinational command relationships; and differences in perceptions of victory and justness of the two conflicts. Some of these factors were not only conducive to minimizing effects of capability differences on the air campaign, they also colored perceptions of these effects. For example, given the emphasis on coalition cohesion and glow of the overwhelming victory achieved by the coalition in Desert Storm, capability differences were probably downplayed. Similarly, focus on USAF/USN friction in the Gulf kept the spotlight off allied shortfalls.

## **Dealing with the Gap**

Better multinational and interservice training at both the operational and tactical levels is one way to deal with the gap without purchasing hardware. Even with the five months of Desert Shield, coalition pilots across the board named combined exercises like Red Flag as the best preparation for what they faced in Desert Storm. Multinational tactical flying training continues to improve, with the formerly US-only Green Flag exercise now open to selected allied participants. Combined training is expanding at the operational level as well, as formerly US-only Blue Flag air operation center (AOC) exercises now include selected allied staff participants. Allied representation at exercise like Blue Flag needs continued expansion to complement campaign planning training conducted at combined air operation centers (CAOC) in Korea and NATO, especially with the push in the USAF to 'weaponize' the AOC.

## **Physically Closing the Gap**

Physically closing the capabilities gap faces the conflicting dynamics of economics and security. While US defense firms seek exports, there will always be a tension between safeguarding military technological advantage and enhancing the interoperability of allies. The example of Europe highlights the danger of promoting US hardware and threatening the viability of European defense industries. Domestic politics come into play as well, as the congressional scrutiny of equipment sales to Saudi Arabia and other Gulf States before and during Desert Shield promises to continue. From an allied domestic perspective, increased defense expenditures may be viewed by a skeptical public as unwarranted in the new-world order. Therefore NATO's DCI is a noble effort but member nations may be hard pressed to execute it.

In short, Desert Storm does provide insights into what 'gaps' may be easier to close than others, especially just prior to or during hostilities.

## **Laser Designators and PGMs**

Most of the major players in the coalition had a laser designation capability and shortfalls resulted from numbers and types of PGMs available to those respective forces. Munition transfers of CBU-87 to the British, British 1000 pound time delay bombs to the US, and LGBs to the Canadians suggest a method of dealing with this situation in the future. Allies should concentrate on acquiring common laser designation equipment and aircraft LGB carriage racks or 'hard points.' With this up front investment by allies the US can stockpile LGBs, usually the greater expense in a PGM capability, for sale to allies in times of crises. GPS guided weapons offer another possibility, where the laser designator can be replaced with another sensor, such as a synthetic aperture radar, to refine target aiming.

## **Electronic IFF**

The IFF issue has two components: transponders and interrogators. IFF transponders are relatively inexpensive and already used by several allies. The short notice installation of this equipment into the RAF aircraft just prior to Desert Storm illustrates how quickly jets can be modified. The mixing and matching of aircraft types

amongst US allies and potential adversaries suggest the identification problem will only get harder in the future. In Desert Storm F-1s sold and flown by the French were the major concern, in Allied Force it was Mig-29s. Allies flying with IFF transponders reduce the fratricide potential in addition to making beyond visual range employment easier for allied fighters.

Interrogation equipment is different because the technologies involved in systems such as non-cooperative target recognition are considered more sensitive. Of the two methods used during Desert Storm, only the F-15C employed both. Unless allied fighters can acquire similar capabilities, either future US led coalition DCA plans will rely on the USAF F-15C, or its replacement, or air-to-air ROE will have to be modified to account for other fighter's limited interrogation capability. Expectations of minimum fratricide promise to make easing of the ROE criteria for beyond visual range employment difficult.

### **Air Refueling and Electronic Combat**

The Desert Storm coalition relied on US systems in these two categories, and future coalitions will probably do the same. Air refueling aircraft are seen as offensive or out of area operation assets since they add little to defense sovereignty. Some allies will operate token air refueling aircraft but are more likely to upgrade combat forces than maintain large and expensive tanker fleets. In Desert Storm, allies used small numbers of electronic intelligence collectors, such as the RAF Nimrod and French C-160, in addition to the British anti-radiation missile. Currently the Germans also have the electronic version of the Tornado, which has an anti-radiation missile capability. However, like air refueling, expense will preclude individual allies from acquiring the aggregate number of tactical jammers, electronic intelligence collectors, and other dedicated electronic combat platforms that the US maintains. Areas allies can affordably upgrade include aircraft self-protection technology like radar warning receivers and electronic countermeasures to ease the burden on coalition SEAD platforms.

## **High/Low Mix**

Closing the gap through acquisition is the politician's problem, and does nothing for the air campaign planner or multinational package leader who has to work with whatever the politicians give him. Desert Storm air operations resemble the present USAF force structure known as the high/low mix. This acquisition and employment scheme calls for small numbers of very capable strike fighters, like the F-117 and F-15E, and large numbers of 'less' capable strikers in the form of F-16s and A-10s. The high end forces gain air superiority, known in current parlance as 'access,' enabling the low end forces to carry the campaign's weight of effort. Both the USAF and USN plan a similar force structure in the future, with F-22/JSF and JSF/F-18E/F respectively.

US planners should think of fitting allies into this spectrum of capabilities instead of defaulting to a lowest common denominator approach, accepting up front that US tankers and electronic combat assets will carry the load against formidable adversaries. Military planners must also understand that attainment of strategic objectives may require operational and tactical inefficiencies in combined operations. For example, future US aircraft like the F-22 and JSF will not require the same type of SEAD effort conducted in Desert Storm. However, other coalition aircraft probably will, and their safe participation will be vital to the cohesiveness of the coalition. Therefore, where tactically US aircraft could bypass some of the adversaries defenses to strike at higher priority targets, thereby achieving operational effects quicker, strategic goals could call for the neutralization of those defenses to give freedom of maneuver to less capable allies. Despite the association with the dreaded route package system, in Desert Storm kill boxes offered a method of coordinating coalition aircraft with varying weapons delivery and secure communications capabilities and can do the same in the future.

## **Conclusion**

The Desert Storm coalition air force's capabilities ranged across a broad spectrum. Planners overcame these disparities through mass and prosecution of the air war in two separate theaters, Iraq and Kuwait. This study has demonstrated the difficulty of separating the capabilities gap from the conflict's context. Political will is just as important as technological prowess in gauging coalition member's relative contributions.

But one case study forms a shaky basis for drawing definitive conclusions, and this study hopefully lays the groundwork for further research into the coalition aspects of Allied Force once primary source data and detailed analyses become available. In the meantime, expense and lack of perceived threat promise to inhibit allies from substantially upgrading their military capabilities. In this regard Desert Storm offers that in some situations employing US led coalitions in a high/low mix provides a conceptual framework for integrating the various capabilities available.

In the end, a better gage of allied capabilities may not be how they stack up to the US but against a potential adversary, especially since this drives other nation's defense budgets. Some of the Gulf States represented the low end of the Desert Storm coalition, yet still contributed against an adversary like Iraq within a US-led effort. Here may be the appropriateness of General Ryan's comments. Since allies cannot modernize to match the US in every category, he provides a funding priority. In order to integrate, the coalition must be able to communicate. With that foundation planners and commanders can fold various capabilities into a comprehensive plan capable of adjusting to the enemy.

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